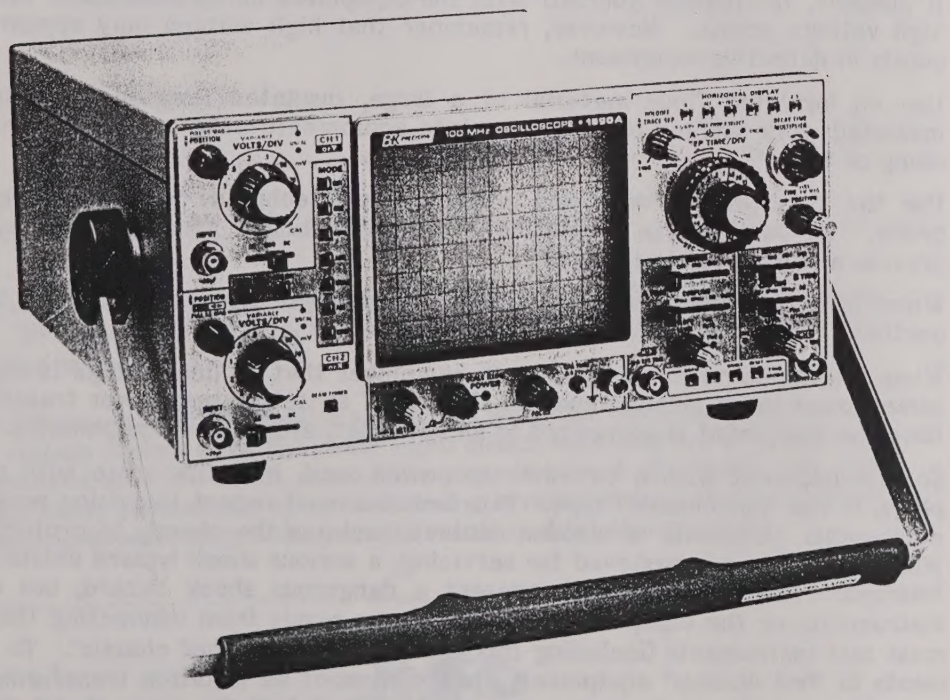
SERVICE MANUAL

Model 1590A

100 MHz

Quad-Trace Oscilloscope



B+K PRECISION

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly in the equipment under test. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Service Manual for

Model 1590A

100 MHz

Quad-Trade Oscilloscope

WARNING

This service manual is intended for use by qualified electronics technicians only. To avoid electric shock, do not perform servicing unless you are qualified to do so.

High voltages up to 20,000 volts dc are present when this instrument is operating. Line voltage is present on the power input circuit whenever the ac power cord is connected to a live outlet, even if the scope is turned off. Observe all high voltage safety precautions when the housing is removed from the oscilloscope. Contacting exposed high voltage could result in fatal electric shock.

BK PRECISION®

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use this address for technical inquiries and replacement parts orders

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REFERENCE PUBLICATIONS

Model 1590A Instruction Manual 480-420-9-001

Model 1590A Composite
(Schematic Diagram & Parts List) 499-309-9-001

Model PR-45 Probe
Service Instructions 494-159-9-001

Model PR-100 Deluxe 100:1 Probe
Instruction Folder 481-170-9-001

SPECIFICATIONS

CRT

Model:	150KTM31
Type:	Rectangular, with internal graticule
Accelerating potential:	20kV
Display area:	8 div x 10 div (1 div = 1 cm)

VERTICAL AXIS (Channel 1 and Channel 2 identical specifications)

Sensitivity	5mV/div to 5V/div (X1 mode) 1 mV/div to 1V/div (X5 mode) 500μV/div (Cascaded operation, CH1 to CH2)
Accuracy:	± 2% (10 ~ 35°C) ± 4% (0 ~ 50°C) ± 7% (Cascaded operation, CH1 to CH2)
Attenuator:	5mV/div to 5V/div in 1-2-5 sequence, all 10 ranges with fine adjustment. between steps.
Input resistance:	1 MΩ ± 1%
Input capacitance:	Approx 22pF
Frequency response	
DC:	DC to 100 MHz (–3 dB) DC to 140 MHz (–6 dB) (unapplied x 5 GAIN mode) DC to 70 MHz (–3 dB) Cascaded operation, CH1 to CH2
AC:	5 Hz to 100 MHz (–3 dB) 5 Hz to 140 MHz (–6 dB) (unapplied x 5 GAIN mode) 7 Hz to 70 MHz (–3 dB), Cascaded operation, CH1 to CH2
Risetime:	3.5ns
Signal delay time:	Approx 10ns as displayed on CRT screen
Crosstalk:	–40 dB minimum
Operating modes:	
CH1	CH1, single trace
CH2	CH2, single trace
DUAL	CH1 and CH2, dual trace
ADD	CH1 + CH2 (added) display
QUAD	CH1 ~ CH4, quad trace
ALT	Dual or quad trace alternating
CHOP	Dual or quad trace chopped
CHOP frequency:	Approx 250 kHz, adjustable
Channel polarity:	Normal or inverted, CH2 only inverted
⚠ Maximum input voltage:	800 Vp-p or 400V (dc + ac peak)
Maximum undistorted amplitude:	8 divisions, minimum (DC to 100 MHz)
Bandwidth limiting:	Vertical system bandwidth with the 20 MHz BW pushbutton switch pushed is approximately 20 MHz
Delay time difference	
CH1 to CH2:	Less than 0.5ns
CH1, CH2 to CH3, CH4:	Less than 1ns

VERTICAL AXIS (Channel 3 and Channel 4 common specifications)

Sensitivity	0.1V/div, 1V/div ± 2%
Attenuator:	1/1, 1/10
Input resistance:	1 MΩ ± 1%
Input capacitance:	Approx. 22 pF
Input coupling mode:	DC only
Frequency response:	DC to 100 MHz (–3 dB) DC to 140 MHz (–6 dB)
Risetime:	3.5ns
Signal delay time:	Same as CH1 and CH2
Maximum allowable voltage	
DC component:	± 0.5V or less (ac + dc) (± 5V, 1/10 attenuated)
AC component:	1 Vp-p (10 Vp-p, 1/10 attenuated) or less
⚠Maximum input voltage:	400V (dc + ac peak)

HORIZONTAL AXIS (Channel 2 input)

Modes:	X-Y mode is switch selectable (HORIZ DISPLAY)
X-Y mode:	CH1: Y-axis CH2: X-axis
Sensitivity:	Same as CH2
Accuracy:	Same as CH2
Input resistance:	Same as CH2
Input capacitance:	Same as CH2
Frequency response:	
DC:	DC to 5 MHz (–3 dB) DC to 7 MHz (–6 dB)
AC:	5 Hz to 5 MHz (–3 dB) 5 Hz to 7 MHz (–6 dB)
X-Y phase difference:	Less than 3° at 100 kHz

SWEEP

Modes	(switchable with the HORIZ DISPLAY switch):
A	A sweep
ALT	B sweep waveform is displayed as an intensified portion of the A sweep and B sweep alternating
A-INT-B	B sweep waveform is displayed as an intensified portion of the A sweep.
B DLY'D	Delayed B sweep

SPECIFICATIONS

DUAL — Dual sweep – A and B sweeps, independently

X-Y — X-Y display mode

A sweep time: 20 ns/div to 0.5s/div in 23 ranges, in 1-2-5 sequence, verninier control provides fully adjustable sweep time between steps.

B sweep time: 20ns/div to 50ms/div in 20 ranges, in 1-2-5 sequence.

Accuracy: ±2% (10 ~ 35°C)
±4% (0 ~ 50°C)

Sweep magnification: X10 ±5% (10 ~ 35°C)
±6% (0 ~ 50°C)

Linearity: 20ns/div to 0.5s/div ±3% (±5% with X10 magnification)

HOLDOFF: Continuously adjustable for A sweep from NORM to X5

Trace separation: B positionable up to 4 divisions separated from A sweep, continuously adjustable.

Delay method: Continuous delay, Trigger delay

Delay time: 0.2 to 10 times the sweep time from 200ns to 0.5s, continuously adjustable.

Time difference measurement accuracy:
±(1% of measurement + 0.1% of full scale) (10 ~ 35°C)
±4% (0 ~ 50°C)

Delay jitter: 1/20000 of the full scale sweep time.

TRIGGERING

A TRIG

A trigger modes: AUTO, NORM, SINGLE, FIX: at the center of the waveform

Trigger source: V MODE, CH1, CH2, (EXT) CH3 1/1 and 1/10, LINE

Coupling modes: AC, LFREJ, HFREJ, DC, VIDEO
VIDEO-LINE sync automatically selected at sweep times of 50 μs/div to 20ns/div.
VIDEO-FRAME sync automatically selected at sweep times of 0.5s/div to 0.1ms/div.

Trigger level: ±90° adjustable

Polarity: +/–

B TRIG

B trigger modes: STARTS AFTER DELAY, TRIGGERABLE AFTER DELAY

Trigger source: CH1, CH2, (EXT) CH4 1/1 and 1/10

Coupling modes: AC, LFREJ, HFREJ, DC

Trigger level: ±90° adjustable

Polarity: +/–

TRIGGER SENSITIVITY (A AND B)

COUPLING	FREQ RANGE	MINIMUM SYNC AMPLITUDE		
		INT	EXT	EXT 1/10
DC	DC ~ 20 MHz DC ~ 50 MHz DC ~ 100 MHz	0.5 div 1.0 div 1.5 div	50 mV 100 mV 210 mV	0.5V 1.0V 2.1V
AC	Same as for DC but with increased minimum level for below 20 Hz.			
AC HFREJ	Increased minimum level below 20 Hz and above 30 kHz.			
AC LFREJ	Increased minimum level below 30 kHz.			
VIDEO	FRAME/LINE	0.5 div	50 mV	0.5V

Table-1

AUTO: Same as above specifications for above 50 Hz.

FIX: 40 Hz ~ 20 MHz 1.0 div (100 mV)
40 Hz ~ 100 MHz 1.5 div (210 mV)

Jitter: 0.5ns maximum at 100 MHz
2ns/div sweep rate (X10 MAG on)

CALIBRATING VOLTAGE AND CURRENT

1 kHz ±3% Positive square wave

1V ±1% (10 ~ 35°C)
±2% (0 ~ 50°C)

10 mA ±2% (10 ~ 35°C)
±4% (0 ~ 50°C)

INTENSITY MODULATION

Input signal: TTL level, intensity decreasing with more positive levels

Input impedance: Approx. 10 kΩ

Usable frequency range: DC to 10 MHz

⚠Maximum input voltage: 50V (dc + ac peak)

VERTICAL AXIS OUTPUT

Sampled CH1 output

Output voltage: 50 mVp-p/div (into 50Ω load)

Output impedance: Approx. 50Ω

Frequency response: DC to 100 MHz (–3 dB) (into 50Ω load)

GATE OPUTPUT (A and B)

Output voltage: Approx. 1.5V positive gate (into 500Ω load)

TRACE ROTATION

Electrical, adjustable

POWER SUPPLY

Line voltage: 90 ~ 264 V

Line frequency: 45 ~ 400 Hz

Power consumption: Approx. 55 W (into 100 V, 50 Hz)

SPECIFICATIONS

DIMENSIONS

Width:	284 mm (328 mm)
Height:	138 mm (150 mm)
Depth:	400 mm(471mm)
	( ) dimensions include protrusions from basic case outline dimensions.

WEIGHT 7.4 kg

ENVIRONMENT

Operating temperature and humidity for guaranteed specifications:	10 ~ 35°C, 85% maximum RH
Full operating range:	0 ~ 50°C, 90% maximum RH
Storage temperature and humidity range:	−20 ~ +70°C 80% maximum
Altitude:	
Operating:	5000 m
Non-operating:	12000 m

CRT 150KTM31 SPECIFICATIONS

Screen and shape

Dimensions

Overall length;	380 mm Max.
Face plate dimensions;	149.3 ±3.0 mm
Screen shape;	Rectangular flat face, internal graticule, metal back
Deflection and focusing system;	Electrostatic deflection, electrostatic focusing and post-deflection acceleration
Color;	Green
Persistence;	Midium short
Useful display area;	Y axis.....80 mm X axis.....100 mm

Heating

Heater voltage;	6.0 V
Heater current;	75 mA
Weight;	Approx. 1.1 kg

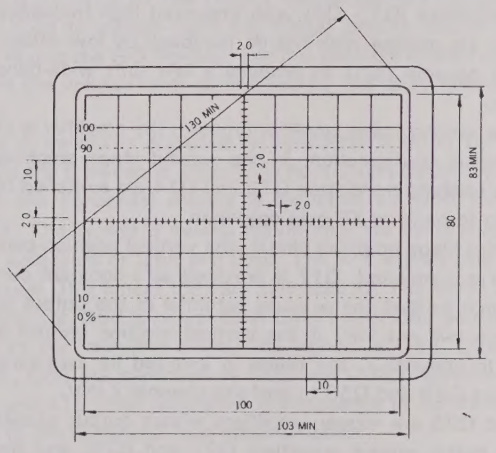


Fig. 1

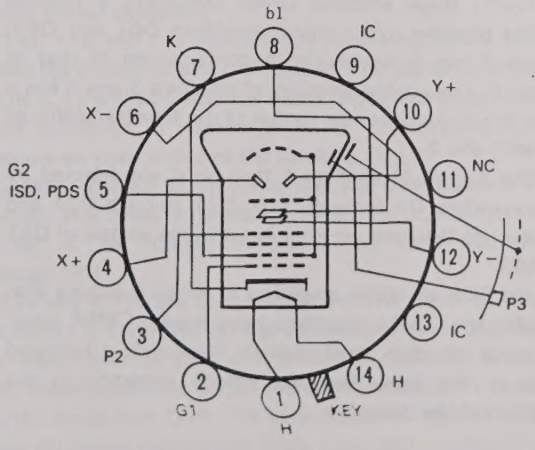


Fig. 2

CIRCUIT DESCRIPTION

VERTICAL ATTENUATOR

The input attenuator unit has a three stage configuration; the attenuation factor of the first stage is 1/100, of the second stage 1/10 and of the third stage 1/2 and 1/4. In combination, these comprise a 10 point input attenuator in 1, 2 and 5 sequence.

The attenuator consists of resistors and capacitors only and does not vary the gain of amplifiers. For this reason, step attenuator balance adjustment is not required.

In addition, since a 1/1000 attenuator is not used, the frequency response is good. The attenuators in both channel 1 and channel 2 use the same configuration.

VERTICAL PRE-AMPLIFIER CIRCUIT

Since this model employs four channel operation, four pre-amplifiers are used.

In the first stage amplifier of channel 1, single-ended transistor amplifiers (Q1 - Q5) with improved high-frequency response are applied with the dc feedback by low offset, low drift op-amp (IC1) to produce a low drift wide-band amplifier.

From the second stage amplifier onward, the amplifier is of a differential configuration. In the second stage amplifier circuit, switching transistors Q13 and Q14 are switched to vary gain to perform X5 gain operation.

In the third stage amplifier circuit, the vertical position control (VR) is connected. Q17 is provided as a constant current source so that the average potential of the output of this stage will not vary if the vertical position control is turned. In channel 2, the phase is inverted by switching transistors Q49 and Q50 to perform channel 2 INV.

Q24 and Q25 are trigger amplifiers whose output passes through buffer output amplifiers Q27 and Q29, and the output signal with an output impedance of 50 ohms is fed to A trigger switch PC board. In channel 1, the CH1 OUT signal is output to the rear panel via Q26 and Q28.

The fourth stage amplifier circuit comprises a cascade amplifier together with mixing amplifiers Q62 and Q63. Channel 2 has a similar circuit configuration to that of channel 1. The second amplifier of channels 3 and 4 has a similar circuit configuration to that of the fourth amplifier of channel 1 and 2.

The four signals of channel 1 through 4 are selected by diode switches D7 through D10, D21 through D24 and D29 through D36 and are connected to the emitter of Q62 and Q63.

Q67 and Q68 are buffer amplifiers to obtain matching with the delay line. These amplifiers have superb CMRR (common mode rejection ratio) in order to provide a balanced output to the delay line and reduce distortion in the waveform of the delay line.

Q73 and Q74 are trigger amplifiers which output the output signal of the mixing amplifier to the A trigger switch unit and are V MODE trigger source. Q64 is a load resistor switching transistor during ADD mode.

Q69 through Q72 make up a 20 MHz band width circuit which sets the frequency response of the vertical axis to 20 MHz, (−3 dB).

The signals of channel 1 through 4 are appropriately switched by a combination of the vertical and horizontal modes by means of the logic circuit consisting of IC3 through IC7.

CH3, CH4 AMPLIFIER CIRCUIT

This circuit consists of the attenuator unit, buffer amplifier, first stage amplifier and trigger amplifier. Q1 drives relay RL1 to switch the attenuator unit to 1/1 and 1/10.

The output signal from this attenuator unit is converted in impedance by Q2 through Q4, amplified by Q5 and Q6, and fed to the second amplifier of the vertical pre-amplifier circuit. At the same time, the trigger signal is passed through trigger amplifiers Q7 and Q8, and applied to the A trigger switch unit.

Although channel 4 has an identical circuit to that of channel 3, the trigger signal is fed to the B trigger switch unit. On the same PC board, the wiring network connecting the CPU unit and trigger sweep unit to the HORIZ DISPLAY and TRIG MODE PC board is incorporated.

VERTICAL OUTPUT AMPLIFIER CIRCUIT

The signal passed through the delay line is applied to the vertical output amplifier. Q1 through Q4 are the cascade connection differential amplifiers. Q14 is a constant current biasing circuit. Q7 through Q12 are final stage output amplifiers; as the cases of Q11 and Q12 are mounted on the chassis to draw off heat, the heat radiation effect is improved compared with former final stage amplifiers. Q15, Q16 and Q17 make up the trace separation circuit, and Q13 and Q18 make up the beam finder circuit.

A TRIGGER SWITCH CIRCUIT

CH1, CH2, CH3, V MODE and LINE trigger signals are fed to the A trigger switch circuit. S1 is a trigger source select switch and S2 is a trigger coupling select switch. Q1 and Q2 are fixed sync circuits which detect the peak value of the trigger input signal to automatically set the trigger level.

Q3 is a dual FET to prevent temperature drift during the dc sync. Q4 and Q5 make up the emitter follower circuit which serves to lower the driving impedance for the following stage. Q6 and Q7 are feedback amplifiers which improve the CMRR (common mode rejection ratio) of both polarities of the trigger signal. Q8 and Q9 are circuits which prevent temperature drift. Q10 through Q15 are cascode amplifiers and make up a switching circuit of the negative and positive polarities of the trigger signal.

Q17 through Q25 are video sync circuits. Q17 through Q19 make up a switching circuit of the negative and positive polarities of the trigger signal and Q21 and Q22 make up a trigger waveshape circuit. Separation and selection of the vertical and horizontal sync signals are performed by Q24 which is interlocked with the SWEEP TIME/DIV control. Q16 receives the trigger signals from Q10 through Q15 or Q25 and feeds the trigger signal to the trigger sweep unit with an output impedance of 50 ohms.

B TRIGGER SWITCH CIRCUIT

Basically, this is the same as the A trigger switch circuit. However, the B trigger switch circuit does not have the video sync circuit and fixed sync circuit.

Q1 extracts the trigger signal of channel 2, then feeds the X signal to the trigger sweep unit during the X-Y operation.

ROTARY SWITCH CIRCUIT

This is part of the sweep circuit and is mounted on a separate PC board which the rotary switch for selecting the sweep time resistors and the resistors for the holdoff circuit are installed.

TRIGGER SWEEP CIRCUIT

The sweep circuit employs a constant current integrating circuit which charges capacitors with a constant current to provide sawtooth waves. Q13, Q15 and Q17 are switching transistors of capacitors for A sweep time. In the case of the B sweep, Q43, Q45 and Q47 operate in the same manner as in the A sweep.

Q12, Q14 and Q16 are switching transistors for holdoff capacitors of the A sweep. In the case of the B sweep, Q42, Q44 and Q46 operate in the same manner as in the A sweep. The voltage supplied from the constant voltage circuit is converted into the constant current source by the voltage setting circuit consisting of IC3a and Q7 and resistors switched by the rotary switch. The capacitor for the sweep time is charged by this current and its terminal voltage is increased. This voltage is fed to the high impedance buffer amplifier consisting of Q18 and Q19. When the output of this amplifier reaches a certain voltage, IC7d is turned on and the flip-flop IC2b is reset; at the same time, IC2a is set. The output of IC2a turns Q6 on, then short-circuits the capacitor for the sweep time with the result that its terminal voltage is decreased. The constant current circuit formed by Q20 charges any one of holdoff capacitors C12, C16 or C20. The terminal voltage of the capacitor gradually increases and when it reaches a certain value, Q22 turns on. The output of Q22 turns on the Schmitt trigger consisting of IC7c, setting IC2b. The output from IC2b releases IC2a setting and starts sweeping again.

The trigger signal is passed through IC1a and IC1b, then triggers IC2a and releases the set flip-flop to start the sweep which is in sync with the trigger signal. IC1a and IC1b make up the Schmitt trigger circuit.

The trigger signal shaped by IC1a and IC1b is applied to IC1c, Q1 and Q2. When the trigger signal is present, the gate of IC1d is closed and IC2a acts as a master-slave flip-flop. When the trigger signal disappears, as the gate of IC1d opens, IC2a acts as an R-S flip-flop. This is an auto free-running circuit.

Q24 through Q26 are the detection circuit for delayed sweep. When a voltage level detemined by the delay time multiplier is reached, Q24 turns on and the gate of IC8a is triggered. IC8a and IC10b make up the logic differentiating circuit which produces a pulse with a certain pulse width. This pulse sets IC5b and starts the B sweep. The B sweep circuit is almost the same as the A sweep circuit except that the B sweep circuit does not have three ranges of low speed sweep.

The B STARTS AFTER DELAY switch permits the gate of the IC4d to switch from the trigger priority master-slave flip-flop to the R-S flip-flop, and it is possible to start sweep from the voltage level determined by the delay time multiplier.

The A sweep is adjusted in horizontal position by Q53 while the B sweep is adjusted in horizontal position by Q54 and the horizontal display is switched by Q55 through Q58. The A and B sweep waveforms are synthesized at the collectors of Q55 and Q58. The X-Y signals also pass through Q59 where they are synthesized. The signal passed through Q60 is improved in CMRR with Q62 before it is fed to the following stage. The signals at Q64, Q65 and Q66, Q68 are switched by Q69 and Q68 respectively to X1 and X10, then converted in impedance to 50 ohms and fed to the horizontal final stage amplifier.

Q77 through Q79 is a trace separation circuit which supplies two types of bias voltage to the vertical output amplifier by means of the select signals of the A and B sweeps. IC8d is a reset pulse generating circuit during single sweep operation.

IC13a, 14a, and 14e also produce a blanking control signal when the horizontal axis is displayed. This signal is combined by IC11 and 12d with the sweep signal and chop signal, then converted in impedance by Q72 through Q75 to become an input signal to the blanking circuit.

The channel select signal during dual and quad traces in the vertical axis mode is produced by IC12a, IC12b, IC13b, IC14c, IC15a, IC15b, IC15c, IC15d, Q76 and D62 through D64.

IC12a and IC12b are chop oscillators. The on/off of these oscillators is controlled by the vertical axis mode logic and the signal from the CPU unit. While the oscillation is stopped, these oscillators output the alternate signal by receiving the signal from Q76. The output from IC12a and IC12b turns off during vertical axis single trace, and is output in all other modes. The output from IC15d is fed to the vertical pre-amplifier and becomes the chop signal and alternate signal.

CIRCUIT DESCRIPTION

CALIBRATION VOLTAGE GENERATOR CIRCUIT

Q80 and Q81 make up a multivibrator circuit, and the signal decreased in impedance by Q82 is output as a calibration voltage. This voltage is changed into constant current by R307 and R308 and output to the current calibration loop on the rear panel. The power sources to all these circuits are stabilized by IC16 before being supplied.

HORIZONTAL OUTPUT AMPLIFIER CIRCUIT

The sweep signal supplied from the trigger sweep circuit is amplified by differential amplifier Q1 and Q2. The output from Q1 and Q2 is converted in impedance by the emitter-follower circuit Q3 and Q4 and drives Q5 and Q6. Q7 and Q8 make up a constant current circuit. These circuits each serve as a dc load for Q5 and Q6, and are provided with ac peaking by means of C11 and C12. Q9 and Q10 make up an auto biasing circuit which automatically determines the operation point of the output stage, These circuits also serve as a beam finder circuit; when the base of Q11 is grounded, the operation point of the output stage decreases and serves to compress the output waveform.

CPU CIRCUIT

The control of vertical MODE, HORIZ DISPLAY and TRIG MODE is performed by the CPU.

By means of the software key scanning system, the signal corresponding to the mode switch pressed is processed, and "L" output is sent to each LED indicator and each unit as a control signal.

The CH2 INV signal and 20 MHz B.W. switching signal are individually fed to the CPU, and their LED indicators are activated by the circuit in the vertical pre-amplifier.

As the lithium battery serves as a memory back-up power supply, information is held in memory even when the power is switched off.

SWITCHING POWER SUPPLY UNIT

Although this unit aims is compact and lightweight, it consumes nearly 55 W power. Therefore, the conventional series regulator system using a power transformer is not able to meet the specification. For this reason, a switching regulator is employed in this unit.

This switching regulator directly rectifies a voltage of 90 - 264 V, whose output is then converted into a dc current by smoothing capacitors. Next, this dc current is switched by power transistors and converted into ac current to drive the converter transformer. The converter transformer has six taps on its secondary winding. The six ac outputs are each rectified and filtered and supply dc outputs to the power blanking unit. However, the voltage at the control winding is compared with the reference voltage, then amplified by the differential amplifier. The output from the differential amplifier controls the base of the power transistor as the control winding is separate and isolated from the primary winding, thereby stabilizing the output voltage from the secondary winding.

POWER BLANKING UNIT

Of the six voltages output from the switching power supply unit, five are stabilized by the series regulator again. Q1 and Q3 through Q6 are control transistors. IC1a, IC1b, IC2a and IC2b are differential amplifiers. With respect to the +20 V supply, as its stabilization is not so important, a voltage divider type regulator is used.

The dc-dc converter for high voltage employs the same circuit as conventional models. Q24 through Q26 make up a differential amplifier and Q28 is a control transistor. This scope allows the brightness of the A and B sweep to be varied independently. Q11 through Q13 are responsible for this operation.

Q14 is a beam finder circuit and even if the INTENSITY control is set to CCW., this circuit serves to provide trace on the CRT.

Q15 and Q16 make up an external intensity modulation circuit which darkens the screen of the CRT with "H" level signal of the TTL level.

These signals are synthesized at the base of Q17, and drive Q18. Q19 is a dc load for Q18 and is provided with ac peaking by C25.

Q20 and Q21 are an auto-focus circuit, and oposite phase signal to phase the blanking waveform is applied to the focus electrode of the CRT.

Q22 and Q23 are dc restorer circuit for the blanking and auto-focus circuits and configured as a differential amplifier, so that an isolated signal can be fed to each circuit. Q8 is a transistor for scale illumination, and Q9 and Q10 are transistors for trace rotation.

FILTER UNIT

L1 and C1 through C3 make up a line filter which prevents noise entering from the power line; the line filter also prevents the unit's internal signal radiating through the power line.

IC1 is a photocoupler which provides the trigger source for the line sync.

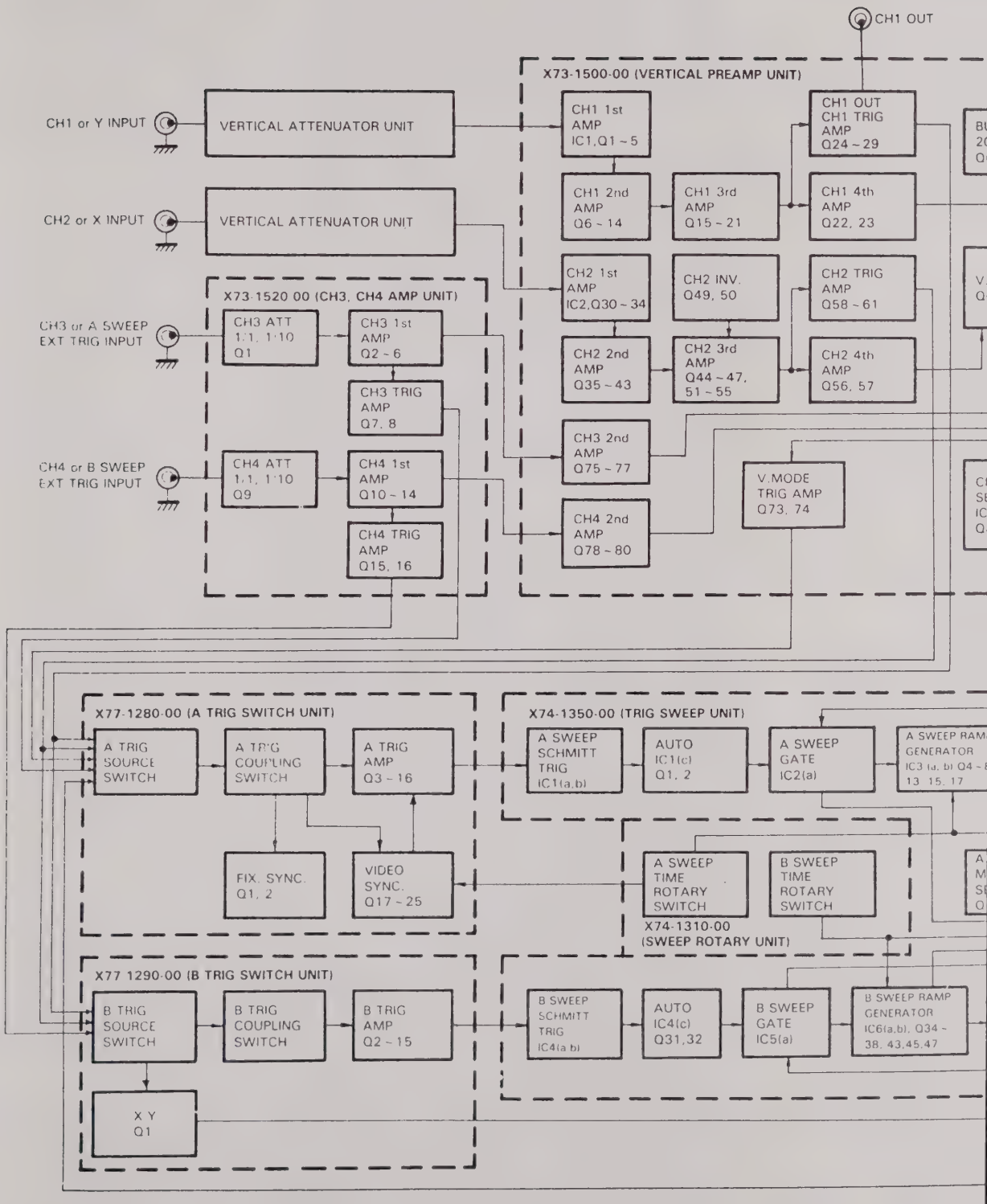
HIGH VOLTAGE BLOCK

The acceleration voltage at the subsequent stage of the unit extends to as much as 18 kV. Therefore, if the high voltage rectifier section is exposed, it is potentially dangerous. Besides, leakage current would not meet the safety standards. So, the unit employs a high voltage block whose high voltage rectifier section is solidified with resin. The dc-dc converter transformer and the rectifier circuit for 2 kV cathode voltage are incorporated in this block. The external output includes −2 kV dc, 6 V ac and 18 kV, which are output from the anode cap. Therefore, unless the anode cap is intentionally removed, as all other voltages are dc output, the high voltages are in the order of approx. 1/2

to 1/3 as compared with our former oscilloscope models, thereby eliminating danger.

ASTIGMATISM CONTROL UNIT

In the power blanking unit, the variable resistor for trace rotation and the variable resistor for astigmatism control are mounted on a separate PC board to allow these controls to be adjusted on the front panel.


CH1 OUT
X73-1500-00 (VERTICAL PREAMP UNIT)
CH1 or Y INPUT
VERTICAL ATTENUATOR UNIT
CH1 1st AMP IC1,Q1 ~ 5
CH1 OUT CH1 TRIG AMP Q24 ~ 29
CH1 2nd AMP Q6 ~ 14
CH1 3rd AMP Q15 ~ 21
CH1 4th AMP Q22, 23
CH2 or X INPUT
VERTICAL ATTENUATOR UNIT
CH2 1st AMP IC2,Q30 ~ 34
CH2 INV. Q49, 50
CH2 TRIG AMP Q58 ~ 61
X73-1520 00 (CH3, CH4 AMP UNIT)
CH3 or A SWEEP EXT TRIG INPUT
CH3 ATT 1/1, 1/10 Q1
CH3 1st AMP Q2 ~ 6
CH3 TRIG AMP Q7, 8
CH2 2nd AMP Q35 ~ 43
CH2 3rd AMP Q44 ~ 47, 51 ~ 55
CH2 4th AMP Q56, 57
CH4 or B SWEEP EXT TRIG INPUT
CH4 ATT 1/1, 1/10 Q9
CH4 1st AMP Q10 ~ 14
CH4 TRIG AMP Q15, 16
CH3 2nd AMP Q75 ~ 77
V.MODE TRIG AMP Q73, 74
CH4 2nd AMP Q78 ~ 80
X77-1280-00 (A TRIG SWITCH UNIT)
A TRIG SOURCE SWITCH
A TRIG COUPLING SWITCH
A TRIG AMP Q3 ~ 16
FIX. SYNC. Q1, 2
VIDEO SYNC. Q17 ~ 25
X74-1350-00 (TRIG SWEEP UNIT)
A SWEEP SCHMITT TRIG IC1(a,b)
AUTO IC1(c) Q1, 2
A SWEEP GATE IC2(a)
A SWEEP TIME ROTARY SWITCH
B SWEEP TIME ROTARY SWITCH
X74-1310-00 (SWEEP ROTARY UNIT)
X77 1290-00 (B TRIG SWITCH UNIT)
B TRIG SOURCE SWITCH
B TRIG COUPLING SWITCH
B TRIG AMP Q2 ~ 15
X Y Q1
B SWEEP SCHMITT TRIG IC4(a,b)
AUTO IC4(c) Q31,32
B SWEEP GATE IC5(a)
B SWEEP RAMP GENERATOR IC6(a,b), Q34 ~ 38, 43,45,47

CK DIAGRAM

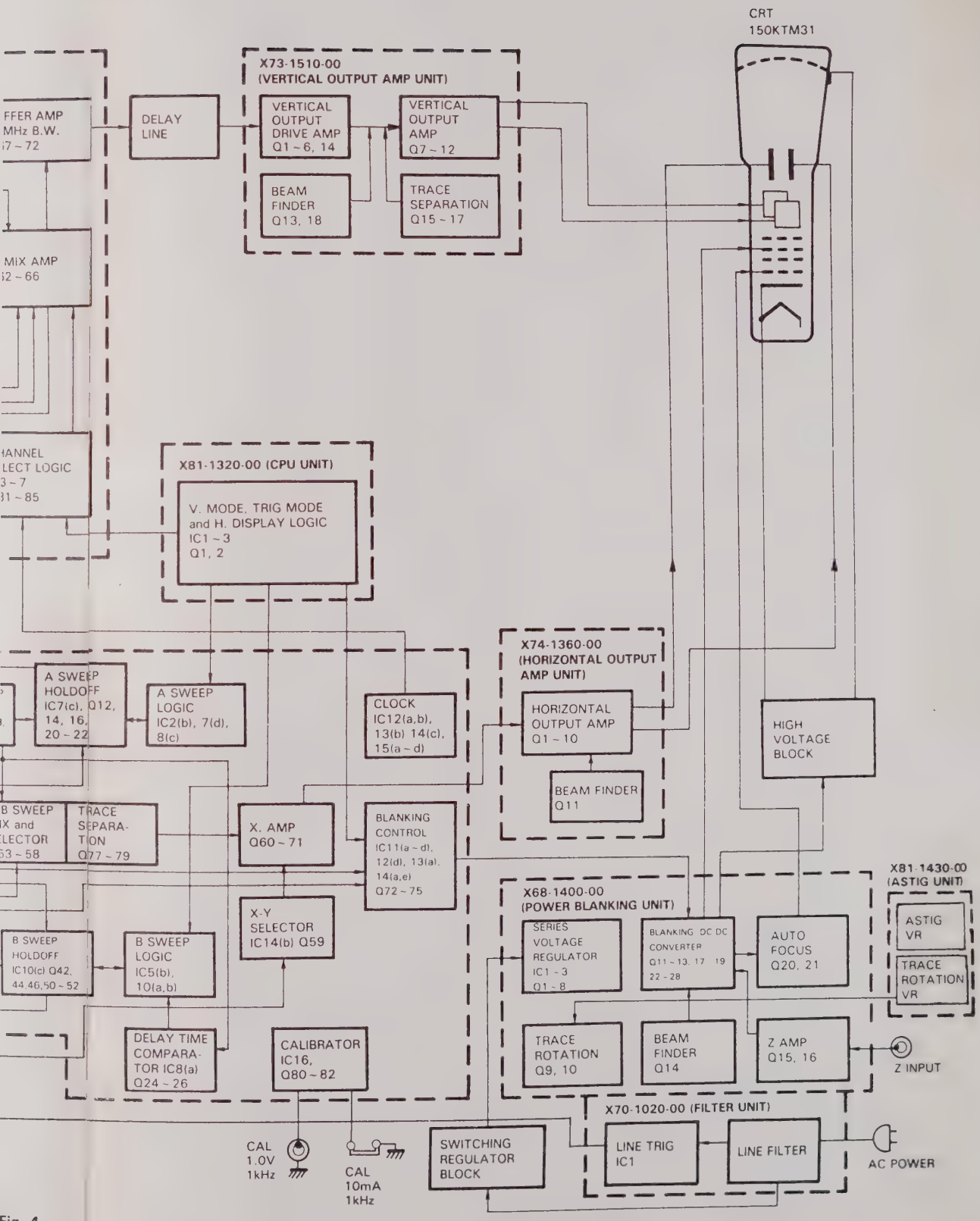


Fig. 4

MAINTENANCE

REMOVAL OF CASE

1. Remove the 4 screws located at the rear of the case and the 1 located at bottom with a ⊕ screwdriver. Carefully slide the body forward from the case.
2. To install the body in the case, place the case horizontally and slide the body into the case using the rails located at the bottom of the case. Then, place the body vertically and engage the case front edge into the front panel groove.
3. Temporarily insert the case retaining screws and then tighten them evenly.

CAUTION:
A voltage of 20 kV is applied to the CRT socket and anode cap. Before removing the case, turn the power off and pull out the power plug. After removing the case, take care not to touch them.

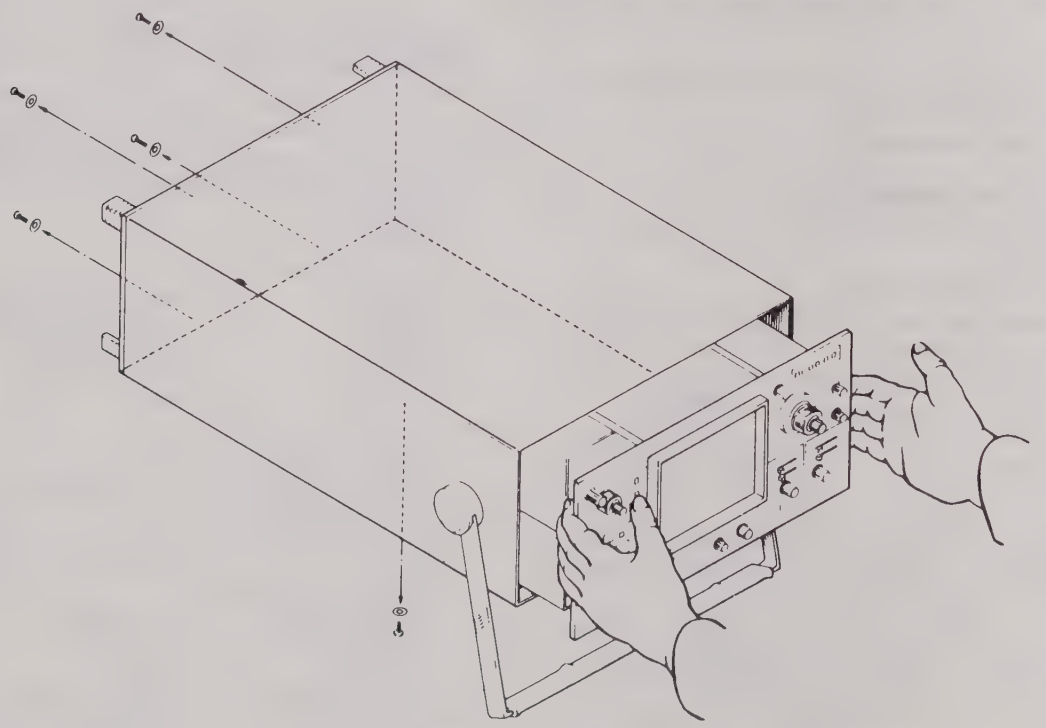


Fig. 5

REMOVING/INSTALLING CRT

1. To remove the cathode ray tube for servicing, disconnect the parallel cord connector located at the top of the shield case. Remove the screws securing the shield case.
   Remove the bracket screws without loosening the CRT band, move the CRT backward and remove the CRT by lifting up the socket.
2. To install the CRT, move the CRT together with the shield case to the front and tighten the screws securing the CRT band and shield case.
3. As slots are provided in the CRT brackets and the brackets are inclined by 45°, the CRT can be moved back and forth and right and left and positioned at any position.
   Always secure the CRT band first, then the CRT brackets.

CAUTION:
There is a high tension voltage at the anode of the CRT. Before removing the CRT, connect the anode to the ground via a 100 kΩ load for 5 seconds to discharge the voltage.

TROUBLESHOOTING

1. If one of the mode LEDs does not light, the unit will not operate correctly. When using the unit, confirm that the LED lights up.
2. To service the unit effectively, isolate the falure first. Then, remove the case and check the wiring, P.C.B. pattern and parts.

ADJUSTMENT

To obtain the best performance, periodically accurately calibrate the unit.
Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated.
When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.
The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer.
For optimum adjustment, turn the power on are warm up the scope sufficiently (more than 30 minutes) before starting.

NOTE:
Calibrate the unit under the following condition.
Temperature: 10 — 35°C
Hunmidity: Less than 85%

POWER SUPPLY VOLTAGE

Before calibrating the unit check the power supply voltage. (90 ~ 264 V).

TEST EQUIPMENT REQUIRED

The following instrument of their equivalent should be used for making adjustments.

Test Equipment	Model	Minimum Specification
Digital Multi-Meter		Impedance: More than 10MΩ, Measuring range: 0.01 V to 199V
Sine Wave Generator	SG-502 (Tektronix)	Frequency: 10 Hz to 10MHz, constant voltage over tuning range
Sine Wave Generator	SG-503 (Tektronix)	Frequency:50kHz to 100MHz, Output impedance: 50 Ω, constant voltage over tuning range.
Square Wave Generator	PG-506 (Tektronix)	Output signal: 1 kHz, Amplitude: 10 mVp-p to 10 Vp-p, Accuracy: within ±1%, Rise time: 35ns or less (1 MHz, 1ns or less)
Q Meter		—
Color Pattern Generator		—
Oscilloscope	475A (Tektronix)	Sensitivity: More than 5 mV Frequency response: More than 250 MHz
Time Marker Generator	TG-501 (Tektronix)	Time mark: 0.5s to 0.1 μs repetitive waveform, Accuracy: within 0.1%
High Voltage Probe	—	Input Impedance: 1000 MΩ
Termination		Impedance: 50 Ω
Attenuator	011-0059-02 (Tektronix)	—20 dB attenuation (50 Ω)

Table-2

Test Equipment	Model	Minimum Specification
Power Meter		—
Auto transformer (variable)		—
Current Probe	P6302 AM-503 (Tektronix)	—
Frequency Counter		—

Table-3

PREPARATION FOR ADJUSTMENT

Control Setting

The control settings listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing a adjustment, return the controls to the following settings.

Power Section

POWER	ON

CRT Control Section

A INTENSITY	Between 12 and 3 o'clock position
B INTENSITY	Between 12 and 3 o'clock position
FOCUS	Optimum position
SCALE ILLUM	Arbitrary position
BEAM FIND	OFF

Vertical Section

VARIABLE (CH1 and CH2)	CAL
▲ ▼ POSITION (CH1 ~ CH4)	12 o'clock position
AC-GND-DC (CH1 and CH2)	AC
VOLTS/DIV (CH1 and CH2)	5V/DIV
×5 GAIN	OFF (PUSH)

Horizontal Sweep Section

A SWEEP TIME/DIV	0.1ms/DIV
B SWEEP TIME/DIV	0.1ms/DIV
A VARIABLE	CAL
DELAY TIME MULT	Arbitrary position
▲ ▼ TRACE SEP.	Fully CCW
HOLDOFF	NORM
B ENDS A	OFF
◄ ► POSITION	12 o'clock position
FINE PULL×10 MAG	12 o'clock position (×10 MAG OFF)
PULL CHOP F. SELECT	OFF (PUSH)

TRIG. Section

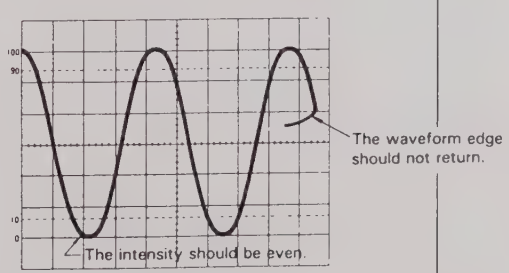
A SOURCE	V MODE
A COUPLING	AC
A LEVEL	12 o'clock position
A SLOPE	+
FIX	(PUSH)
B SOURCE	CH1
B COUPLING	AC
B LEVEL	12 o'clock position
B SLOPE	+
STARTS AFTER DELAY	(PUSH)

Mode Section

Vertical MODE	CH1
20 MHz BW	OFF
CH2 INV	OFF
TRIG MODE	AUTO
HORIZ DISPLAY	A

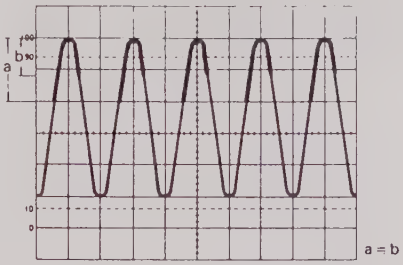
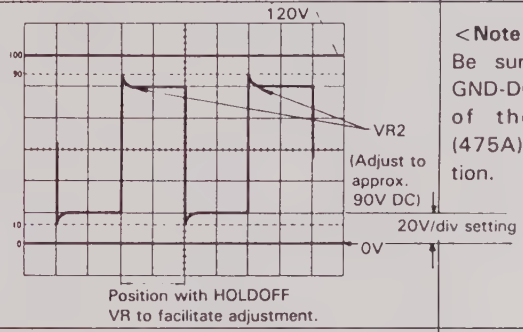
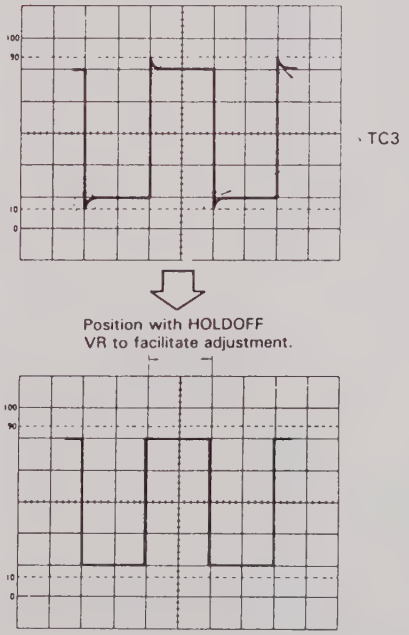
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
ADJUSTMENT OF POWER SUPPLY AND CRT					
Check of Power Supply		X68-1400			(1) Measurement 1P P27 +120V P30 +130V±3V
Adjustment of −2.0 kV	VR3	X68-1400	High voltage probe		(2) Measure the (−2.00kV~
Coarse Adjustment of ASTIG and FOCUS	VR9 FOCUS Knob	X81-1430		HORIZ DISPLAY: X-Y CH1, CH2 AC-GND-DC: GND A INTENSITY: 3 o'clock 20MHz BW: ON	(1) Operate ▲▼ PO center of the (2) Adjust VR9 to
Adjustment of A INTENSITY	VR1	X68-1400		HORIZ DISPLAY: X-Y A INTENSITY: 9 o'clock CH1, CH2 AC-GND-DC: GND 20MHz BW: ON	Adjust VR1 so tha TY is set in the po <Check> Make sure that th INTENSITY is turn when A INTENSIT
Check of B INTENSITY				HORIZ DISPLAY: ALT Vertical MODE: CH1 TRIG MODE: AUTO STARTS AFTER DELAY: PULL CH1 AC-GND-DC: AC B SWEEP TIME/DIV: 0.1ms	(1) Operate ▲▼ TR screen. (2) Make adjustn brightness wh extinguished (3) Make adjustn TENSITY is tu
Adjustment of Blanking	TC2	X68-1400	SG-502	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO A SOURCE: V MODE A COUPLING: AC A INTENSITY : Fully CW CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 0.02μs	(1) Apply a sine TION, ◄► P with a vertica (2) Make adjustn at the wavef
Adjustment of Z-axis Input Blanking	TC1	X68-1400	SG-503	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO A SOURCE: V MODE CH1 AC-GND-DC: DC VOLTS/DIV: 2V	(1) Set A SWEEP 10Vp-p to CH div appears o (2) Apply the sa CCW so that (3) Adjust so that peak point.

JUSTMENT

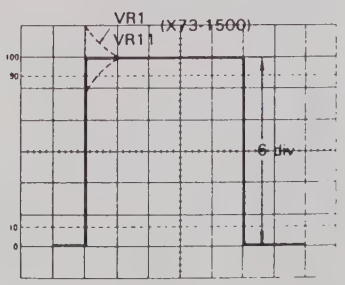
Adjustment and Check	Illustration	Remark
and checking of voltages at P27 and P30 pins 2P: 55 ± 1V; 3P: 20V; 4P: 55V; 5P: 24V ± 2V; 6P: 12V +1.5V −0.5V; 7P: 5.2V; 8P: 7V ± 0.5V; 9P: 10V; 10P: −10V; 11P: −12V +0.5V −1.5V		
voltage on 2P of P33 and adjust VR3 to obtain −2.00kV -2.005kV).		
SITION knobs for CH1 and CH2 to position the spot in the CRT screen.) make the spot round and smaller.		
t the spot on the CRT screen disappears when A INTENSI- sition of 9 o'clock. e spot on the CRT screen increases in brightness when A ied CW and that the trace becomes almost extinguished Y is turned CCW (9 o'clock position).		
ACE SEP to cause B sweep line in the center of the CRT ient so that the trace on the CRT screen increases in en B INTENSITY is turned CW and that the trace becomes when B INTENSITY is turned to fully CCW. ient so that the trace becomes extinguished when B IN- rned to fully CCW.		
vave signal of 10 MHz to CH1 INPUT and operate ▲▼ POSI- OSITION and CH1 VOLTS/DIV to bring out a waveform l amplitude of 6 div on the screen. ient so that there is no unevenness in intensity of the trace rm starting point and there is no retrace.		
TIME/DIV at 0.5 μs and apply a 1 MHz sine wave signal of 1 INPUT so that a waveform with a vertical amplitude of 5 the screen. ne signal above to the Z INPUT, and turn A INTENSITY the dark and bright area of the waveform are distinct. the bright area of the sine waveform is symmetrical to the		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of Auto FOCUS Level	VR2	X68-1400	475A Probe (1/10)	HORIZ DISPLAY: A A INTENSITY: Fully CW TRIG MODE: AUTO Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV:20μs HOLDOFF: NORM	(1) Set the oscilloscope (2) Observe the wavefo FTP marked pattern of top of the square
Adjustment of Auto FOCUS Wave Forming	TC3	X68-1400		HORIZ DISPLAY: A A INTENSITY: Fully CW TRIG MODE: AUTO Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 20μs HOLDOFF: NORM	Make adjustment so that
Adjustment of ASTIG and FOCUS	VR9 FOCUS Knob	X81-1430		HORIZ DISPLAY: X-Y CH1, CH2 AC-GND-DC: GND A INTENSITY : 3 o'clock	(1) Operate ▲▼ POSITION into the center of th (2) Make adjustment to <**Check**> (1) Make sure that the turned CW or CCW. (2) Make sure that the F 3 o'clock when the s (3) The most ideal point tions and adjustment

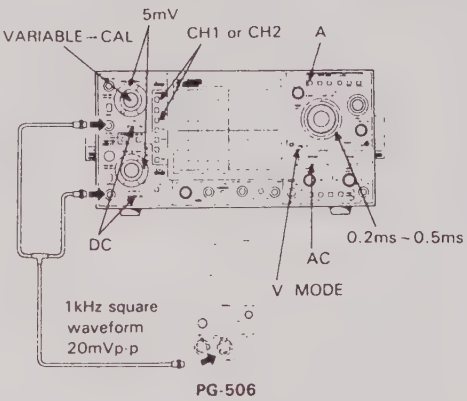
STMENT

Adjustment and Check	Illustration	Remark
		
(475A) for the vertical axis sensitivity at 2V/div. orm of AUTO FOCUS circuit (Autofocus test point with a probe and make adjustment so that DC level wave is approx. 90V (4.5 ~ 5 div.)		<Note> Be sure that the AC-GND-DC selector switch of the oscilloscope (475A) is at "DC" position.
the above-mentioned circuit has an ideal waveform.		
for CH1 and CH2 so that the bright spot is brought e CRT screen. make the spot round and smaller. bright spot grows larger when the FOCUS knob is OCUS knob is in a position within the range of 9 and pot is smallest. should be obtained by repeating the above opera-		<Note> Be sure to bring the bright spot into the center of the CRT screen. It may be difficult to obtain the correct adjusting position near the edge of the screen due to the CRT peripheral blur.

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of Trace Rotation	VR8	X81-1430		HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: GND	(1) Operate ▲▼ POSIT screen. (2) Make adjustment line. <Check> (1) Make sure that t from the horizon
Adjustment of CRT Center	VR3	X73-1510		HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: GND	Short-circuit the test becomes aligned with
ADJUSTMENT OF VERTICAL AXIS (I)					
Adjustment of CH1 DC BAL	VR2	X73-1500		HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: GND CH1 VOLTS/DIV: 5mV CH1 X5 GAIN: PULL	(1) Turn CH1 VARIA (2) Adjust CH1 ▲▼ P horizontal center (3) Turn CH1 VARI becomes aligned screen. (4) Repeat the above <Check> Movement of trace
Adjustment of CH2 DC BAL	VR12	X73-1500		HORIZ DISPLAY: A Vertical MODE: CH2 TRIG MODE: AUTO CH2 AC-GND-DC: GND CH2 VOLTS/DIV: 5mV CH2 X5 GAIN: PULL	Same with the adjust
CH1 Waveform Shaping in the Low Range (5mV range)	VR1	X73-1500	BNC-BNC cord PG-506	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO A SOURCE: V MODE CH1 AC-GND-DC: DC CH1 VOLTS/DIV: 5mV CH1 VARIABLE: CAL	(1) Apply a 1 kHz oscillator output (2) Adjust VR1 to sh
CH2 Waveform Shaping in the Low Range (5mV range)	VR11	X73-1500		HORIZ DISPLAY: A Vertical MODE: CH2 TRIG MODE: AUTO A SOURCE: V MODE CH2 AC-GND-DC: GND CH2 VOLTS/DIV: 5mV CH2 VARIABLE : CAL	With vertical MODE described above to m

Adjustment and Check	Illustration	Remark
ON for CH1 to move the trace to the center of the CRT to align the trace with the horizontal center graticule ne trace moves more than 0.5 div (10°) up and down al center graticule line at its righthand end.		<Note> When the trace does not appear fully across the screen, make proper adjustment by operating VR9 (X74-1350) and VR7 (X74-1350).
point of X73-1500 and adjust VR3 so that the trace the horizontal center graticule line.		
BLE knob to fully CCW. SITION so that the trace becomes aligned with the graticule line on the CRT screen. BLE to CAL and make adjustment so that the trace with the horizontal center graticule line on the CRT procedure. less than 0.3 div.		<Note> If the trace does not come to the center of the screen even when ▲▼ position is operated, adjust VR6 (X73-1500).
nent of CH1 DC BAL.		<Note> CH2 position center can be adjusted by VR16 (X73-1500).
square wave signal to CH1 INPUT and adjust the o produce a waveform of 6 div on the CRT screen. ape the square waveform in the low range.		
selected to CH2, perform the same operations as ake adjustment.		

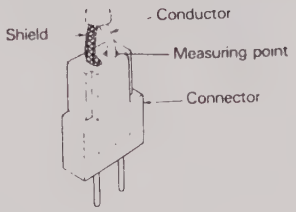
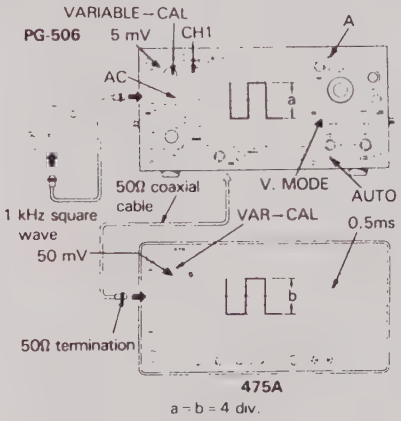
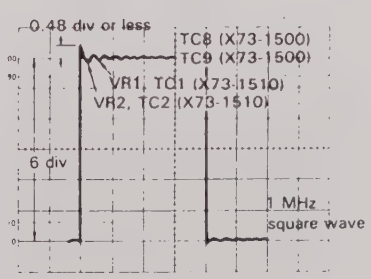
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of CH1 Gain	VR7	X73-1500	BNC-BNC cord (T junction) PG-506	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO A SOURCE: V MODE CH1 AC-GND-DC: DC CH1 VOLTS/DIV: 5mV CH1 VARIABLE: CAL 20MHz BW: ON	(1) Apply a square wave PUT. (2) Vertical MODE select t waveform in the cente (3) Synchronize by operati (4) Adjust VR7 so that th div. <Check> Turn CH1 VOLTS/DIV an amplitude will be 4 to 6 div Sensitivity error wit
Adjustment of CH2 Gain	VR18	X73-1500		HORIZ DISPLAY: A Vertical MODE: CH2 TRIG MODE: AUTO A SOURCE: V MODE CH2 AC-GND-DC: DC CH2 VOLTS/DIV: 5mV CH2 VARIABLE: CAL 20MHz BW: ON	(1) With vertical MODE se form the same operati check. <Check> (1) Select vertical MODE t CH1 and CH2 and app CH2 INPUT jacks. Make sure that CH1 ar (2) Switch vertical MODE CH2 INV pushbutton pressed). Operate ▲▼ P trace in the center of t not be obtained, adjust Channel error within
Adjustment of CH3 Gain and CH4 Gain	VR21 VR23	X73-1500 X73-1500	PG506	HORIZ DISPLAY: A Vertical MODE: QUAD, ALT A SOURCE: 1/1 B SOURCE: 1/1 A SWEEP TIME/DIV: 0.2ms TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND	(1) Apply a 0.5Vp-p, 1 kH CH4 INPUT jacks and a tain synchronization. Operate CH3 and CH4 center of the CRT scre (2) Make adjustment so th becomes 5 div respecti <Check> (1) Sensitivity error must b ment of CH1 Gain) (2) With A SOURCE and B square wave signal 5 V trols to bring the wavef The amplitude at this ti

Adjustment and Check	Illustration	Remark
gnal of 20 mVp-p, 1 kHz to CH1 and CH2 IN- CH1 and operate CH1 ▲▼ POSITION to produce a of the CRT screen. g A trigger LEVEL. vertical amplitude of the waveform becomes 4 input a reference signal so that the vertical n each range. n ±2%	 PG-506	<Refrence> Method of calculatin of sensitivity error Sensitivity error = $\frac{a-b}{b}$ × 100% a = CRT screen amplitude b = Input signal voltage : (VOLTS/DIV) (Example): CRT screen amplitude: 4.2 div Input signal: 20mVp-p 1 kHz square wave VOLTS/DIV: 5mV Sensitivity error = $\frac{4.2\text{div} - 20\text{mV}/5\text{mV}}{20\text{mV}/5\text{mV}}$ × 100 = 5%
ected to CH2, turn VOLTS/DIV to 5 mV and per- ns as described above to make adjustment and DUAL and ALT position and turn VOLTS/DIV for a square wave of 20 mVp-p, 1 kHz to CH1 and d CH2 have the same amplitude. o ADD and A SOURCE to CH1 (CH2) and press witch (the lamp will go on when this switch is SITION for CH1 and CH2 to produce a single e CRT screen. If a single and straight trace can- VR7 again %		<Note> Overshoot or tilt might appear to the reference signal of 1 kHz square wave. In this case, make corase adjustment of square wave characteristics.
square wave signal simultaneously to CH3 and djust A trigger LEVEL and B trigger LEVEL to ob- ▲▼ POSITION controls to bring the pattern to the n. at the amplitude of CH3 and CH4 waveforms ely. within ±2%. (See to reference for the adjust- SOURSE switches set to 1/10, make the 1 kHz -p and operate CH3 and CH4 ▲▼ POSITION con- rm to the center of the CRT screen. he must be within the range of 4.9~5.1 div.		<Note> If tilt or overshoot occurs to the 1 kHz waveform, refer to the section devoted to CH3 and CH4 waveform shaping.

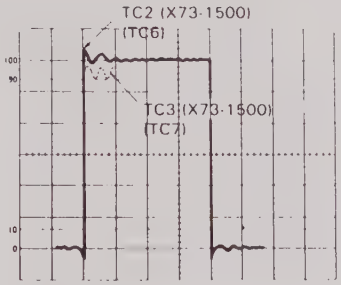
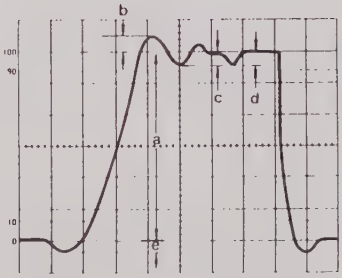
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of CH1 ▲▼ POSITION and CH2 ▲▼ POSITION	VR6 VR16	X73-1500 X73-1500		Vertical MODE: DUAL, ALT HORIZ DISPLAY: A TRIG MODE: AUTO CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC: GND CH1, CH2 ▲▼ POSITION: 12 o'clock A SWEEP TIME/DIV: 0.1ms	Adjust VR6 and VR the horizontal cent <Check> (1) The deviation must be within (2) When ▲▼ POSIT each trace mu turned fully CC
Adjustment of CH2 INV Position	VR17	X73-1500			Press CH2 INV (the tion at CH2 NORM <Check> (1) Vertical deviati (2) Press CH2 INV moves more th when the knob
Adjustment of CH3 ▲▼ POSITION and CH4 ▲▼ POSITION	VR22 VR24	X73-1500 X73-1500		HORIZ DISPLAY: A Vertical MODE: QUAD, ALT A SOURCE: 1/1 B SOURCE: 1/1 TRIG MODE: AUTO CH3, CH4 ▲▼ POSITION: 12 o'clock A SWEEP TIME/DIV: 0.1ms	Adjust VR22 and with the horizontal <Check> (1) The deviation must be within (2) When ▲▼ POSIT each trace mus turned fully CC
Adjustment of CH1 X5 Gain and CH2 X5 Gain	VR4 VR14	X73-1500 X73-1500	PG-506	HORIZ DISPLAY: A Vertical MODE: DUAL, ALT TRIG MODE: AUTO CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC: DC CH1, CH2 X5 GAIN: PULL A SWEEP TIME/DIV: 0.2ms CH1, CH2 VARIABLE: CAL	(1) Apply a square adjustment so (2) Apply the sam <Check> (1) The sensitivity (2) For both CH1 pulled and go (3) The UNCAL la are operated t (CCW)
Adjustment of CH1 X5 Gain Position and CH2 X5 Gain Position	VR5 VR15	X73-1500 X73-1500		HORIZ DISPLAY: A Vertical MODE: DUAL, ALT TRIG MODE: AUTO CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC: GND CH1, CH2 X5 GAIN: PULL CH1, CH2 ▲▼ POSITION: 12 o'clock A SWEEP TIME/DIV: 0.1ms	Adjust VR5 and VR with the horizontal <Check> The distance from

Adjustment and Check	Illustration	Remark
16 so that the CH1 and CH2 traces become aligned with r graticule line on the CRT screen. rom the horizontal center graticule line on the CRT screen ±1 div. ION controls for both CH1 and CH2 are turned fully CW, t move upward more than 4 div and when the knobs are W the trace must move downward more than 4 div.		
lamp is on) and adjust VR17 to bring the trace to its posi- (the lamp is off). on between CH2 NORM and INV must be within ±0.5 div and turn CH2 ▲▼ POSITION fully CW and see if the trace an 4 div upward and it moves more than 4 div downward is turned fully CCW.		
/R24 so that the CH3 and CH4 traces become aligned center graticule line on the CRT screen. rom the horizontal center graticule line on the CRT screen ±1 div. ION controls for both CH3 and CH4 are turned fully CW, t move upward more than 4 div and when the knobs are W, each trace must move downward more than 4 div.		
wave signal of 5 mVp-p, 1 kHz to CH1 INPUT and make that the CRT screen amplitude becomes 5 div. signal to CH2 and make the similar adjustment. error must be within ±2% and CH2, the lamp must go on when PULL X5 GAIN is ff when the knob is pressed. mp must go off when CH1 and CH2 VARIABLE controls CAL and go on when the knobs are turned to UNCAL.		<Note> If no waveform appears on the screen when the knob is pulled, make coarse adjustment by operating X5 Gain Position Adjustment. CH1: VR5 (X73-1500) CH2: VR15 (X73-1500)
15 so that the traces of CH1 and CH2 become aligned center graticule line on the CRT screen. he center graticule line must be within ±1 div.		<Note> If sometimes happens that the trace grows thicker at X5 GAIN, thus making it difficult to obtain proper adjustment. In this case, press 20 MHz BW (the lamp is on) button switch to make the line thinner.

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of CH1 DC Trigger Level CH2 DC Trigger Level CH3 DC Trigger Level CH4 DC Trigger Level	VR10 VR19 VR1 VR2	X73-1500 X73-1500 X73-1520 X73-1520		HORIZ DISPLAY: A Vertical MODE: QUAD CH1, CH2 AC-GND-DC: GND TRIG MODE: AUTO	(1) Operate CH1 and CH2 trols to align the trace v (2) Make adjustment so th (−0.008 ~ +0.008 V). Item of Adj CH1 DC Trigger Leve CH2 DC Trigger Leve CH3 DC Trigger Leve CH4 DC Trigger Leve
Adjustment of V MODE Trigger DC Level	VR20	X73-1500		Vertical MODE: CH1 CH1 AC-GND-DC: GND	(1) Operate CH1 ▲▼ POSITI line on the CRT scr en. (2) Make adjustment so tha is zero (−0.008 ~ +0.(
Adjustment of CH1 OUT Gain	VR8	X73-1500	475A 50Ω Termination 50Ω Coaxial cable PG-506	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: AC CH1 VOLTS/DIV: 5mV CH1 VARIABLE: CAL	(1) Set the vertical axis se GND-DC to DC. (2) Connect the cable to oscilloscope (475A) via (3) Apply a 1 kHz square v output and ▲▼ POSITIO downward from the ho (4) Make adjustment so t 4 div.
Adjustment of CH1 OUT DC Level	VR9	X73-1500		HORIZ DISPLAY: A Vertical MODE: CH1 CH1 AC-GND-DC: GND TRIG MODE: AUTO	(1) Operate CH1 ▲▼ POSIT graticule line on the CR (2) Make adjustment so t becomes less than 0V (
Adjustment of Square wave Characteristics of CH3	VR1 TC1 VR2 TC2 TC8	X73-1510 X73-1510 X73-1510 X73-1510 X73-1500	PG-506 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: QUAD, ALT TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND A SOURCE: CH3 1/1 A COUPLING: AC A SLOPE: +	(1) With A SOURCE to 1/ INPUT and adjust the 6 div on the CRT scre (2) Adjust VR1 and TC1 range. (3) Adjust VR2 and TC2 t (4) Adjust TC8 to shape t <Check> Overshoot: less than

Adjustment and Check	Illustration	Remark
▲▼ POSITION and CH3 and CH4 ▲▼ POSITION con- with each other on the center of the CRT screen. at the voltage at all the check points may be zero Adj control / Check point VR10 / P15 (X73-1500) VR19 / P16 (X73-1500) VR1 / P17 (X73-1520) VR2 / P18 (X73-1520)	 	<Note> Use the connector lead for making measurement at the check points. Adjust the voltage in the conductor to zero.
ON to align the trace with horizontal center graticule t the voltage in the conductor of the connector P19 008 V).		
nsitivity of oscilloscope (475A) to 50 mV and AC- CH1 OUT on the rear panel of CS-2110 and the 50Ω termination. wave signal to CH1 INPUT and adjust the oscillator V so that the amplitude may be 2 div upward and rizontal center graticule line on the CRT screen. that the oscilloscope (475A) waveform becomes	 	
ION to align the trace with the horizontal center T screen. hat the voltage in the connector P21 (X73-1500) ± 10 mV).		
1 (CH3) apply a 1 MHz square wave signal to CH3 oscillator output to produce a square waveform of en. - to shape the square waveform in the medium o shape the square waveform in the high range. he square waveform in the ultra-high range. 8%	 	<Note> When shaping the waveform, terminate the input terminal of oscilloscope to match the output impedance of the oscillator.

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of Square wave Characteristics of CH4	TC9	X73-1500	PG-506 50Ω Termination	HORIZ DISPLAY: B DLY'D Vertical MODE: QUAD, ALT TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND B SOURCE: CH4 1/1 B COUPLING: AC B SLOPE: +	Apply a 1 MHz squar in (4) above to shape <Check> Overshoot | les
Adjustment of Square wave Characteristics of CH1 5 mV Range	TC3 TC2	X73-1500 X73-1500	PG-506 50Ω 20dB Attenuator 50Ω Termination 50 Ω Coaxial cable (BNC-BNC)	HORIZ DISPLAY: A TRIG MODE: AUTO CH1 AC-GND-DC: DC CH1 VOLTS/DIV: 5mV A SOURCE: CH1 A COUPLING: AC A SLOPE: + CH1 VARIABLE: CAL	(1) Set vertical MOD signal to CH1 IN oscillator output input terminal mu oscillator. When mination. (2) Adjust TC3 to sh (3) Adjust TC2 to sh Overshoot |
Adjsutment of Square wave Characteristics of CH2 5 mV Range	TC7 TC6	X73-1500 X73-1500		HORIZ DISPLAY: A TRIG MODE: AUTO CH2 AC-GND-DC: DC CH2 VOLTS/DIV: 5mV A SOURCE: CH2 A COUPLING: AC A SLOPE: + CH2 VARIABLE: CAL	Set vertical MODE to <Check> With VOLTS/DIV rem SWEEP TIME/DIV is 100 kHz to 10 kHz, Overshoot | less
CH1, CH2 Waveform Shaping in the Low Range (10 mV range)	TC1 TC5	X73-1500 X73-1500	PG-506 BNC-BNC cord	HORIZ DISPLAY: A Vertical MODE: CH1 or CH2 TRIG MODE: AUTO A SOURCE: V MODE CH1, CH2 AC-GND-DC: DC CH1, CH2 VOLTS/DIV: 10mV CH1, CH2 VARIABLE: CAL	(1) Apply a 1 kHz oscillator output In doing this, m 10mV range is e (2) Set vertical MOD

Adjustment and Check	Illustration	Remark
wave signal to CH4 INPUT and take the same steps as the waveform. than 8%		
E to CH1 and repeatedly apply a 1 MHz square wave PUT from the square wave oscillator and adjust the so that the amplitude becomes 6 div. In doing this, the st be terminated to match the output impedance of the the output impedance is 50 Ω terminate the 50 Ω ter- ape the square waveform in the high range. ape the square waveform in the ultra-high range. less than 3%		(1) Adjust A SWEEP TIME/DIV between 20 ns and 0.2 μs so that the waveform is visible. (2) As all measuring instruments are affected, repeat the adjustment individually.
CH2 and make adjustment as in the case of CH1. aining at 5 mV, check the waveform quality when A changed by varying the square wave frequency, from kHz and back to 100 Hz sequentially. than 3%	 a = 6 div. b Overshoot c = Ringing d = Hall e = Pre-shoot	
square wave signal to CH1 INPUT and adjust the to produce a waveform of 5 ~ 6 div. ake adjustment so that the waveform quality of the qual to that of the 5 mV range. E to CH2 and make adjustment as in the case of CH1.		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of CH1 ATT and CH2 ATT		S02-4502 -05	PG-506	HORIZ DISPLAY: A CH1, CH2 AC-GND-DC: DC A SOURCE: V MODE A SWEEP TIME/DIV: 0.2 ms CH1, CH2 VARIABLE: CAL	(1) Shaping of waveform Apply a 1 kHz square just the oscillator out this, make adjustmen equal to that of the 5 (2) Input capacity (22 pF Connect a Q-meter justment so that the i 5mV range.
CH3 Waveform Shaping	TC2 (A SOURCE 1/10)	X73-1520	PG-506	HORIZ DISPLAY: A Vertical MODE: QUAD, ALT A SOURCE: CH3 1/1 A SWEEP TIME/DIV: 0.2ms TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND	(1) Apply a 1 kHz square just the oscillator out screen. (2) With A SOURCE set t manner and adjust TC
CH4 Waveform Shapping	TC6 (B SOURCE 1/10)	X73-1520		HORIZ DISPLAY: DUAL Vertical MODE: QUAD, ALT A SOURCE: CH3 1/1 B SOURCE: CH4 1/1 A SWEEP TIME/DIV: 0.2ms B SWEEP TIME/DIV: 0.2ms	(1) Apply a 1 kHz square take the same steps a
Adjustment of CH3 Input Capacity	TC3 (1/10)	X73-1520		A SOURCE: CH3 1/1	(1) Check that the input c 5mV range (22 pF±3 (2) Make adjustment so t become equal to that <**Check**> The difference between A It shall be the same with B

CH1 and CH2 Reference ra

Seque-nce	Adjustment	
1	10mV range	
2	20mV range	
3	10mV range	Ca
4	20mV range	Ca
5	50mV range	
6	50mV range	Ca
7	5V range	
8	5V range	Ca

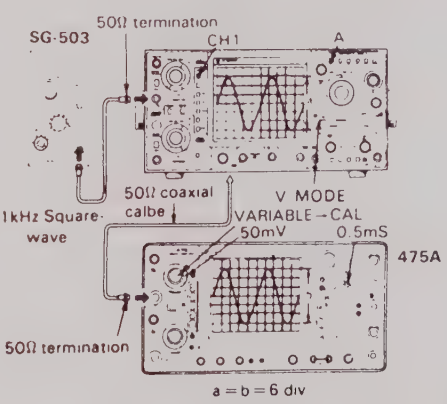
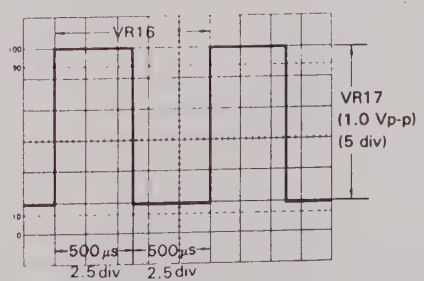
MENT

Adjustment and Check	Illustration	Remark
wave signal to CH1 and CH2 INPUT jacks and adput to produce a waveform of 5 ~ 6 div. In doing t so that the waveform quality of each range is mV range. ± 3 pF) to CH1 and CH2 INPUT jacks and make adnput capacity of each range is equal to that of the ge: 5mV Range Adj. control Wave hape TC6 Wave hape TC8 Input acity TC5 Input acity TC7 Wave hape TC3 Input acity TC4 Wave hape TC1 Input acity TC2		<Note> Be sure to make the adjustment with the shield case being fitted in place.
vave signal of fast rise time to CH3 INPUT and adut to produce a waveform of 6 div on the CRT 1/10, produce a waveform of 6 div in the same 3 to obtain the similar waveform as (1) above.		
wave signal of fast rise time to CH4 INPUT and in (1) above to shape the waveform.		
pacity of CH3 becomes equal to the value of CH1 pF). hat the input capacity of CH3 setted to 1/10 to t 1/1. SOURCE 1/1 and A SOURCE 1/10: less than 1pF. SOURCE.		<Note> Be sure to make adjustment of input capacity after making 1 kHz square waveshape.

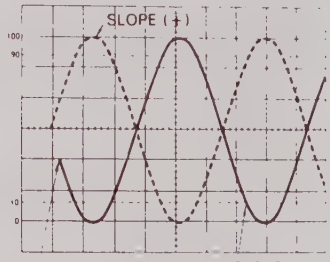
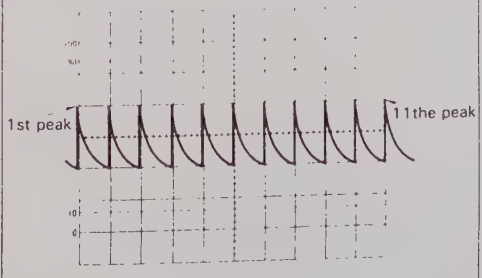
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	
Adjustment of CH4 Input Capacity	TC7(1/10)	X73-1520		B SOURCE: CH4 1/1	Adjust the input capa <Check> Check the input capa
ADJUSTMENT OF VERTICAL AXIS (II)					
Check of 1 MHz Square wave Characteristics **Square wave Characteristics of CH1 and CH2**			PG-506 50Ω Termination	HORIZ DISPLAY: A A SOURCE: V MODE A SWEEP TIME/DIV: 0.2 μs ~ 20 ns TRIG MODE: AUTO A COUPLING: AC	(1) Check the squar Turn the VOLTS put so that CH1 ly. (2) The overshoot m
Square wave Characteristics of CH3 and CH4				HORIZ DISPLAY: DUAL, ALT Vertical MODE: QUAD, ALT A SOURCE: CH3 1/1 B SOURCE: CH4 1/1	(1) Apply a 1 MHz s if the overshoot (2) The overshoot n 1/1 to 1/10 and
Check of CH1 and CH2 Frequency Characteristics			SG-503 50Ω Coaxial cable (BNC-BNC) 50Ω 20dB Attenuator 50Ω Termination	HORIZ DISPLAY: A TRIG MODE: AUTO A SOURCE: V MODE A COUPLING: AC CH1, CH2 AC-GND-DC: DC A SWEEP TIME/DIV: 2μs ~ 20 ns	(1) With CH1 VOLT to INPUT and adj on the CRT scre (2) When the freque maining unchang and there must b (3) Perform the sam Frequency char (4) When the speci wave characteris
Adjustment of CH3 and CH4 Frequency Characteristics	TC4 (CH3 1/10) TC8 (CH4 1/10)	X73-1520	SG-503 50Ω Termination 50Ω Coaxial cable (BNC-BNC)	HORIZ DISPLAY: DUAL Vertical MODE: QUAD, ALT TRIG MODE: AUTO A SOURCE: CH3 1/1 B SOURCE: CH4 1/1	(1) Apply a sine w oscillator output (2) When the freque remaining uncha 4.25 div. (3) With A SOURCE 100 MHz is with Frequency chara (4) Perform the sam (5) When the specif characteristics. (6) Perform the sam

Astment and Check	Illustration	Remark
city in same manner as CH3. city in same manner as CH3.		<Note> Be sure to make adjustment of input capacity after making 1 kHz square waveshape.
e wavaracteristics of CH1 and CH2 5 mV range. 'DIV krfor each channel to adjust the oscillator out- and Chill produce a waveform of 6 div, respective- ust be than 3% for each range.		<Note> As the VOLTS/DIV is manually rotated, the amplitude of 6 div cannot be obtained amplitude.
quare v signal to CH3 and CH4 INPUT jacks and see s less 8% at this time. ust be than 8% when A SOURCE is turned from B SOU from 1/1 to 1/10.		
S/DIV o 5 mV, apply a sine wave signal of 50 kHz ust theillator output to produce a waveform of 6 div en. ncy is ed to 100 MHz with the oscillator output re- ed, theplitude on the screen must be over 4.25 div e no sen dips and peaks during attenuation. e operas for CH2. acteris 100 MHz, less than −3 dB fication not satisfied, readjust the 1 MHz square tics.		
ave sig of 50 kHz to CH3 INPUT and adjust the to proc a waveform of 6 div on the CRT screen. ncy is nged to 100 MHz with the oscillator output nged, amplitude on the screen must be over to 1/position adjust TC4 so that the amplitude at in the cification limits. cteristi00 MHz, less than −3 dB e operas for CH4. cation ot satisfied, readjust the 1 MHz square wave e adjustnt for B SOURCE (TC8).		

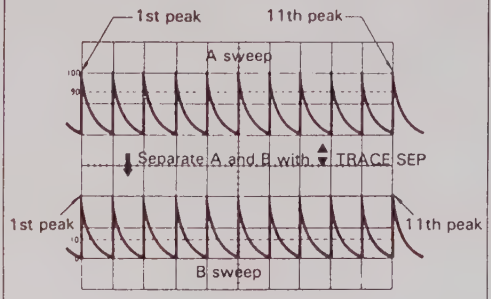
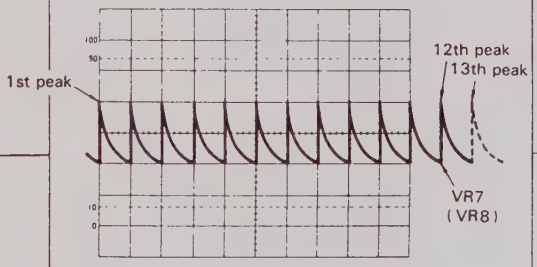
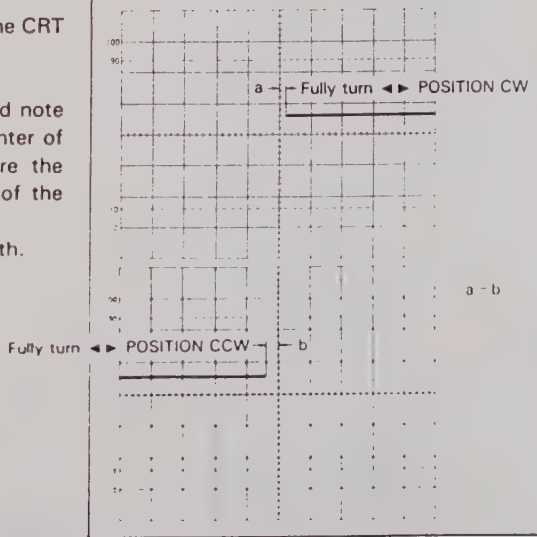
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustmen
Check of CH1 and CH2 X5 GAIN Frequency Characteristics			SG-503 50Ω Termination	HORIZ DISPLAY: A A SOURCE: V MODE TRIG MODE: AUTO CH1, CH2 AC-GND-DC: DC CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 X5 GAIN: PULL	(1) With vertical MODE set to CH1, a CH1 INPUT and adjust the oscilla 6 div on the CRT screen. (2) When the frequency is varied to 1 maining unchanged, the amplitude (3) Set vertical MODE to CH2 and ma X5 GAIN frequency characteristic
Check of 20 MHz BW Frequency Characteristics			SG-503 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE CH1 AC-GND-DC: DC CH1 VOLTS/DIV: 5mV 20 MHz BW: ON TRIG MODE: AUTO	(1) Apply a sine wave signal of 5 waveform of 6 div. (2) Vary the frequency of the input sig put and read the frequency at becomes 4.25 div. This frequen limits. 20 MHz BW frequency characteristics
Adjustment of CH1 OUT Frequency Characteristics	TC4	X73-1500	475A 50Ω Termination (through type) 50Ω Coaxial cord (BNC-BNC) SG-503	CH1 AC-GND-DC: AC CH1 VOLTS/DIV: 5mV CH1 ▲▼ POSITION: 12 o'clock	(1) With the vertical axis sensitivity coaxial cable from CH1 OUT and connect it to CH1 OUT of 475A. (2) Apply a sine wave signal of 50 oscillator output so that the vertic When the frequency is varied oscillator output, adjust TC4 so th 475A becomes over 4.25 div. CH1 OUT frequency characteristic
Adjustment of CAL Output	VR16 VR17	X74-1350 X74-1350	475A		(1) Short-circuit TP1 (X74-1350) and CAL output terminal becomes 1.0 (2) Set the vertical axis sensitivity of 4 0.2 ms. (3) Lead a probe from the calibratio and connect it to CH1 IN (4) Adjust VR16 so that the frequency **<Check>** Frequency: within 1 kHz ±3%. Output voltage: within 1.0 Vp-p ±1% Duty ratio: within (50 ±2)%

and Check	Illustration	Remark
pply a sine wave signal of 50 kHz to or output to produce a waveform of 00 MHz with the oscillator output re- on the screen must be over 4.25 div. ke a similar check. 100 MHz, less than −3 dB.		
) kHz to CH1 INPUT to produce a nal without changing to ocsillator out- which the amplitude on the screen cy must be within the specification frequency of −3dB:15MHz to 25MHz.		
of 475A set to 50 mV, lead a 50Ω erminate it with 50Ω termination and kHz to CH1 INPUT and adjust the al amplitude of 475A becomes 6 div. o 100 MHz without changing the t the amplitude on the CRT screen of 100 MHz, less than −3 dB		<Note> If the square wave characteristics of CH1 PREAMP and V. OUTPUT AMP are readjusted the square wave characteristic and frequency characteristic will also change.
adjust VR17 so that the voltage at V ±1%. 75A to 20 mV and the sweep time to n voltage output terminal (CAL) PUT of 475A. becomes 1 kHz.		<Note> For checking the frequency, a frequency counter (FC-756) may be used.

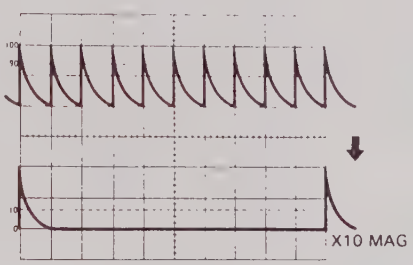
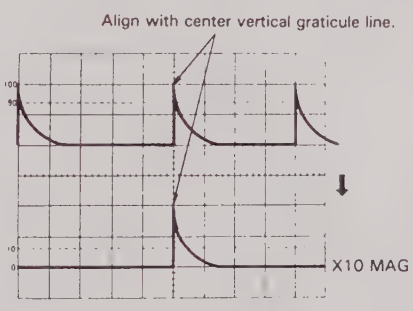
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment
ADJUSTMENT OF HORIZONTAL SWEEP					
Coarse Adjustment of A and B Trigger Center and SLOPE **Coarse Adjustment of A Trigger Center and SLOPE**	VR2 VR4	X77-1280 X77-1280	SG-502	HORIZ DISPLAY: A Vertical MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 0.2ms A SOURCE: V MODE A COUPLING: AC A trigger LEVEL: 12 o'clock A SLOPE: +	(1) Apply a sine wave signal of 1 k oscilloscope output and ▲▼ POSI amplitude 3 div above and below t the CRT screen. (2) Adjust VR2 so that the starting poir horizontal center graticule line on th (3) Set A SLOPE to (−) and adjust VI position of the starting point of the is set to (+).
Coarse Adjustment of B Trigger Center and SLOPE	VR2 VR3	X77-1290 X77-1290	SG-502	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 B COUPLING: AC B trigger LEVEL: 12 o'clock B SLOPE: + A SWEEP TIME/DIV: 0.5 ms B SWEEP TIME/DIV: 0.2 ms TRIG MODE: AUTO ▲▼ TRACE SEP: NORM	(1) Set A INTENSITY to fully CCW. (2) Apply a sine wave signal of 1 kHz t output and ▲▼ POSITION to produ above and below the horizontal cer (3) Adjust VR2 so that the starting poir horizontal center graticule line on th (4) Next, set B SLOPE to (−) and adju the waveform to the position of th duce when B SLOPE is set to (+).
Adjustment of A Sweep Time	VR9	X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO A VARIABLE: CAL	(1) Apply a marker signal of 0.5 ms to (2) Operate ◄► POSITION to bring the left end of the graticule line and adj end of the graticule line.

and Check	Illustration	Remark
Hz to CH1 INPUT and adjust the ION to produce a waveform of ne horizontal center graticule line on of the waveform is aligned with the e CRT screen. 4 to bring the starting point to the waveform produced when A SLOPE	 Align the starting point with the horizontal center graticule line  Align SLOPE (−) with the starting point of SLOPE (+)	
CH1 INPUT and adjust the oscillator ce a waveform of amplitude 3 div ter graticule line on the CRT screen. t of the waveform is aligned with the e CRT screen. st VR3 to bring the starting point of starting point of the waveform pro-		
CH1 INPUT. first peak of the marker signal to the st VR9 for the 11th peak to the right		<Note> (1) When TG-501 is used, set CH1 AC-GND-DC to AC, VOLTS/DIV to 0.5 V/div, thru 50Ω termination. (2) If the 11th peak is not visible, adjust VR7 (X74-1350) for A sweep length adjustment.

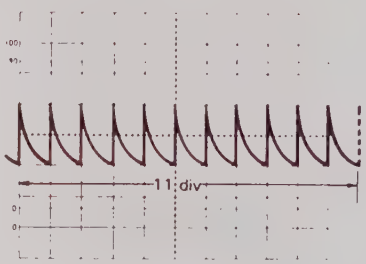
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment
Adjustment of B Sweep Time	VR10	X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A SWEEP TIME/DIV: 0.5ms B SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 0.20	(1) Apply a marker signal of 0.5 ms to (2) On the screen A and B sweeps of (▲▼ TRACE SEP to bring these swee be easily adjusted. (3) Make adjustment so that the first p end of the graticule line on the scre of graticule line on the screen. (4) Make sure that A and B TRIG'D lam
Adjustment of A Sweep Length	VR7	X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO	(1) Apply a marker signal of 0.5 ms to (2) Make adjustment so that the total l
Adjustment of B Sweep	VR8	X74-1350		HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A SWEEP TIME/DIV: 0.5ms B SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 0.20	(1) Apply a marker signal of 0.5 ms to (2) A and B sweeps will appear on the Use ▲▼ TRACE SEP to separate them (3) Make adjustment so that the total l
Adjustment of A Sweep Position	VR11	X74-1350		HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO	(1) Set CH1 AC-GND-DC to GND to bri screen. (2) Set the FINE knob of ◄► POSITIO (3) Turn ◄► POSITION fully CW with the deviation between the starting the screen. Next, turn ◄► POSI distance between the ending point screen. Make adjustment so that these devi Width error | less than 1 div.

and Check	Illustration	Remark
CH1 INPUT. H1 input signal will appear. Operate s into the positions where they can ak of B sweep is brought to the left n and the 11th peak to the right end os are on.		<Note> 1. When TG-501 is used, the knobs must be operated in the same manner as described above. 2. If the 11th peak is not visible adjust VR8 (X74-1350) for B sweep length adjustment. 3. The B sweep time will not change even if A VARIABLE is turned.
CH1 INPUT. ngth is 12 div.		<Note> Turn ◄► POSITION to shift the base line two markers to the left then you can see the 12th time marker with the graticule area.
CH1 INPUT. creen. ngth of B sweep is 12 div.		
g the trace to the center of the CRT to 12 o'clock. ut turning the FINE knob and note oint of the trace and the center of ION fully CCW and measure the of the trace and the center of the tions will have the same width.		

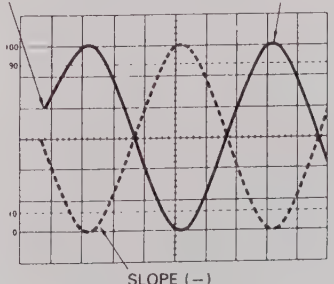
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment
Adjustment of B Sweep Position	VR12	X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A,B SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 0.20	(1) Apply a marker signal of 0.5 ms to A sweep to the leftmost division o (2) Operate ▲▼ TRACE SEP to separat VARIABLE to CAL. (3) Make adjustment so that the start that of A sweep in the horizontal p **<Check>** Operate ▲▼ TRACE SEP so that A swee one another and make sure that thei other.
Adjustment of X10 MAG Gain	VR13	X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO CH1 VOLTS/DIV: 1V CH1 AC-GND-DC: DC	(1) Apply a marker signal of 0.1 ms t of vertical amplitude of about 2 di (2) Align the first peak of the marker s line on the CRT screen and the 11t X10 MAG switch. (3) Make adjustment so that the peak **<Check>** Specification | 10 times ±5%
Adjustment of X10 MAG Center	VR14	X74-1350		HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 0.1ms A VARIABLE: CAL TRIG MODE: AUTO A SLOPE: +	(1) Apply a marker signal of 0.5 ms waveform on the CRT screen. (2) Operate ◄► POSITION to bring t graticule line on the screen. (3) Make adjustment so that the wav center graticule line on the screen MAG position). **<Check>** Repeatedly push and pull the FINE kno waveform does not move. Deviation | less than 1 div.
Adjustment of MAG Center and Gain					Recheck the center at X10 MAG and
Adjustment of A Sweep Time, 50ms, 5μs and 0.1μs.	VR2 (50ms) VR1 (5μs) TC1 (0.1μs)	X74-1350 X74-1350 X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE TRIG MODE: AUTO A VARIABLE: CAL	(1) With A SWEEP TIME/DIV set to 5 CH1 INPUT. (2) Adjust VR2 so that the first peak left end of the graticule on the sc end. (3) Next, rotate the A SWEEP TIME/D to CH1 INPUT and adjust VR1 in t (4) Next, A SWEEP TIME/DIV to 0.1μ INPUT, adjust TC1 in the same m

and Check	Illustration	Remark
—CH1 INPUT and align the first peak of f the CRT screen. e A sweep and B sweep and set A ing point of B sweep is aligned with osition. p and B sweep are superimposed on r starting points coincide with each		
CH1 INPUT to produce a waveform ignal with the left end of the graticule h peak with the right end and pull the to-peak distance is 10 div.		
to CH1 INPUT to produce 3 peaks he central peak to the vertical center form will be aligned with the vertical when the FINE knob is pulled out (X10 b to make sure that the center of the		
Gain.		
Oms apply a marker signal of 50ms to f the marker signal is aligned with the een and the 11th peak with the right IV to 5μs and apply a 5μs time marker he same manner as (2). s and with 0.1μs time marker to CH1 nner as (2).		

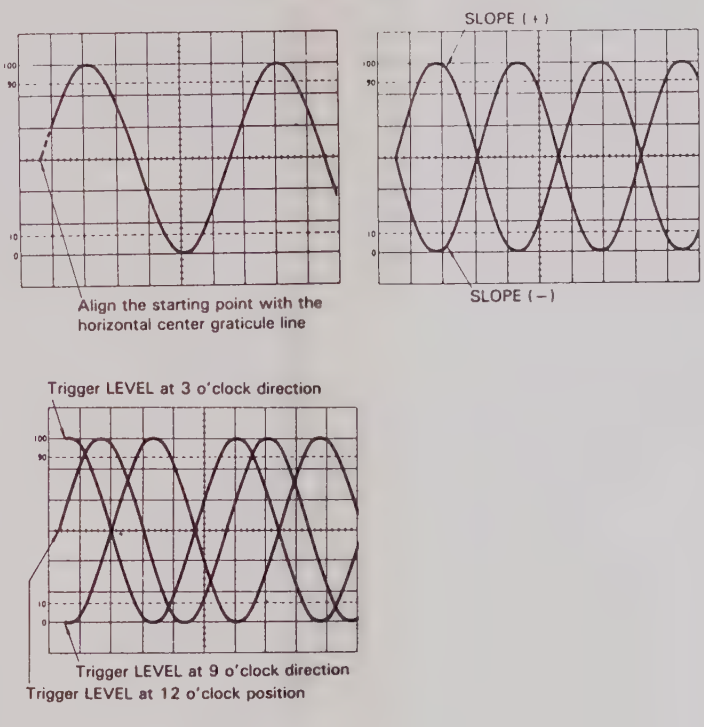
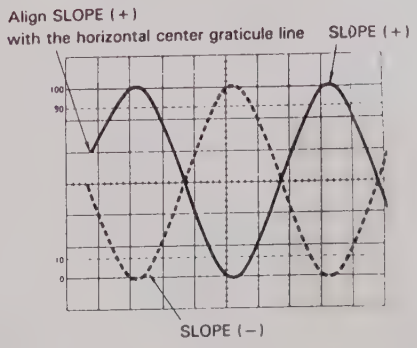
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment
Adjustment of B Sweep Time 50ms, 5μs and 0.1μs	VR4 (50ms) VR3 (5μs) TC2 (0.1μs)	X74-1350 X74-1350 X74-1350	TG-501 50Ω Termination	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A,B SWEEP TIME/DIV: 0.5ms TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 0.20	(1) Set A and B SWEEP TIME/DIV to 50ms to CH1. (2) Operate ▲▼ TRACE SEP to separate positions where adjustment can be (3) Adjust VR4 so that the first peak of left end of the graticule line on the right end. (4) Rotate A and B SWEEP TIME/DIV t CH1 INPUT and adjust VR3 in the s (5) Next, A and B SWEEP TIME/DIV to to CH1 INPUT, adjust TC2 in the s
Adjustment of 20ns A Sweep Linearity	TC3	X74-1350		HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A SWEEP TIME/DIV: 20ns A VARIABLE: CAL TRIG MODE: AUTO A SLOPE: +	(1) Apply a marker signal of 20ns to C (2) Make adjustment so that the total l
Adjustment of 20ns B Sweep Linearity	TC4	X74-1350		HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 1.00	(1) With A and B SWEEP TIME/DIV to to CH1 INPUT. (2) Operate ▲▼ TRACE SEP to separate tions where they can be easily adjus (3) Make adjustment so that the total l
Check of Sweep Time Error in All the Range [I]				HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE TRIG MODE: AUTO A VARIABLE: CAL	(1) Apply a reference time marker si TIME/DIV. (2) Measure the time error rate and ma limits. Specification: within ±2%.
[II]				HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A VARIABLE: CAL TRIG MODE: AUTO A, B SLOPE: + A, B INTENSITY: Fully CW DELAY TIME MULT: 1.00	(1) Operate ▲▼ TRACE SEP to separate tions where they can be easily adjus (2) Apply a reference time marker (50ms — 20ns) of B sweep. (3) Measure the time error rate and ma limits. Specification: within ±2%.

nd Check	Illustration	Remark
50ms and apply a marker signal of A sweep and B sweep to be in the nade easily. the marker signal is aligned with the screen and the 11th peak with the 5μs and apply a 5μs time marker to me manner as (3). 0.1μs and with 0.1μs times marker me manner as (3).		
1 INPUT. ngth of the waveform is 11 div.		
20ns, apply a marker signal of 20ns sweep and B sweep into the posi- ed. ngth of the waveform is 11 div.		
nal for each range of A SWEEP e sure it is within the specification		
sweep and B sweep into the posi- ed. ignal in each of all the ranges e sure it is within the specification		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustme
ADJUSTMENT OF X-Y OPERATION					
Adjustment of X Position Center	VR15	X74-1350		HORIZ DISPLAY: A Vertical MODE: DUAL, ALT CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC: GND A SOURCE: CH1 TRIG MODE: AUTO A SWEEP TIME/DIV: 0.1ms	(1) Operate ▲▼ POSITION for both C traces on one another in the cen (2) Make adjustment so that the b screen when HORIZ DISPLAY is **<Check>** Operate CH2 ▲▼ POSITION and make ed below. (1) When the knob is turned coun more than 5 div. (2) When the knob is turned clockwi 5 div. Distance between the spot and the screen.
Adjustment of X Gain	VR25	X73-1500	PG-506	HORIZ DISPLAY: X-Y CH2 AC-GND-DC: AC CH2 VOLTS/DIV: 5mV	Apply a square wave signal of 20 m justment so that the horizontal ampl
Readjustment of X Position Center and X Gain					Readjust X position Center and X G
Check of X Axis Frequency Characteristic			SG-502	HORIZ DISPLAY: X-Y CH2 AC-GND-DC: DC CH2 VOLTS/DIV: 5mV	(1) Apply a sine wave signal of 1 kH output to produce a waveform (2) When the frequency is varied t output, the amplitude must be Frequency characteristic | DC to
ADJUSTMENT OF TRIGGERING					
Adjustment of A Slope	VR4	X77-1280	SG-502	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A SWEEP TIME/DIV: 0.2ms A SLOPE: + TRIG MODE: AUTO	(1) Apply a sine wave signal of 1 kH output to produce a waveform (2) Operate A trigger LEVEL and may have an amplitude equally graticule line on the CRT screer (3) Set A SLOPE to (−) and make the waveform will be in the waveform when A SLOPE is in **<Check>** (1) Repeatedly turn the A SLOPE k the starting points are in the sa (2) Make sure that the rise slope of the A SLOPE knob is in the (+ chronized when the knob is in (3) Feed the same signal to CH2 ar waveform of CH2 and make su synchronized when the A SLOF chronized when it is at (−) pos

nt and Check	Illustration	Remark
CH1 and CH2 to superimpose the two ter of the CRT screen. right spot comes to the center of the switched in X-Y. sure that the spot will move as describ- erclockwise, the spot moves leftward se, the spot moves rightward more than center of / within ±1 div from the center of the screen.		<Note> When making X-Y adjustment, do not set both CH1 and CH2 to X5 GAIN.
/p-p, 1 kHz to CH2 INPUT and make adtude is 4 div.		
in.		
z to CH2 INPUT and adjust the oscillator f 10 div. 5 MHz without changing the oscillator ver 7.1 div (−3 dB). 5 MHz, less than −3 dB.		
z to CH1 INPUT and adjust the oscillator of 4 ~ 6 div on the CRT screen. H1 ▲▼ POSITION so that the waveform above and below the horizontal center adjustment so that the starting point of position of the starting point of the he (+) position. ob from (+) to (−) and make sure that ne positions. he waveform will be synchronized when position and the fall slope will be syne (−) position. d set vertical MODE to CH2 to produce a e that the rise slope of the waveform is knob is at (+) and the fall slope is syntion.	Align SLOPE (+) with the horizontal center graticule line SLOPE (+)  SLOPE (−)	

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustment a
Adjustment A Trigger Level Center and Fix Sensitivity	VR2 VR3	X77-1280 X77-1280	SG-502	HORIZ DISPLAY: A Vertical MODE: CH1 A SOURCE: V MODE A COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A SWEEP TIME/DIV: 0.2ms A SOURCE: + TRIG MODE: AUTO	(1) Set A trigger LEVEL to 12 o'clock. (2) Apply a sine wave signal of 1 kHz to output to produce a waveform of 4- (3) Operate CH1 ▲▼ POSITION to move th equally above and below the horizon screen. (4) Adjust VR2 so that the starting poin tal center graticule line on the CRT s (5) Pull FIX knob and adjust the sine w waveform of 1 div. (6) When A SLOPE is alternately turned chronize. (7) Repeat (2)~(6) procedures for seve **<Check>** (1) When A SLOPE is alternately turnec must be always on the horizontal ce (2) With A SLOPE remaining in the p clockwise toward 3 o'clock from nea is as shown at right. (3) Adjust the oscillator output so that 0.5 div and make sure that synchror LEVEL.
Adjustment of 100 MHz Trigger	TC1 TC1	X77-1280 X77-1290	SG-503	A, B SOURCE: CH1	(1) Apply a 100 MHz sine wave sigr oscillator output to produce a wavef (2) Adjust TC1 so that the waveform is **<Check>** Adjust the oscillator output so that 0.5 div and make sure that synchroniz LEVEL.
Adjustment of B Slope	VR3	X77-1290	SG-502	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A SOURCE: V MODE B SOURCE: CH1 A, B COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A,B SWEEP TIME/DIV: 0.2ms A VARIABLE: CAL A, B SLOPE: + TRIG MODE: AUTO A, B INTENSITY: Fully CW	(1) Apply a sine wave signal of 1 kHz to output to produce a waveform of 4- (2) Operate A trigger LEVEL, B trigger LE waveform so that its amplitude is equ center graticule line on the screen. (3) Set A INTENSITY to CCW and B INT 3 o'clock. (4) Set B SLOPE to (−) and make adjus the waveform comes to the same waveform when B SLOPE is in the (**<Check>** (1) Turn B SLOPE knob alternately to (- starting point is always on the horizc (2) When B SLOPE is in the (+) positi should be synchronized and its fall sl (3) Apply the same signal to CH2 and se a waveform of E sweep of CH2 on t slope of the waveform is synchroniz fall slope is synchronized at (−).

nd Check	Illustration	Remark
CH1 INPUT and adjust the oscillator ~ 6 div on the CRT screen. he waveform so that its amplitude is tal center graticule line on the CRT : of the waveform is on the horizon- creen. ave input signal of CH1 to obtain a to (+) and (−), adjust VR3 to syn- al times. to (+) and (−), the starting point nter graticule line. osition of (+), turn trigger LEVEL r 9 o'clock and see if the waveform the waveform amplitude becomes ization can be obtained by A trigger		
al to CH1 INPUT and adjust the orm of 0.8 div on the CRT screen. synchronized at 0.8 div. the waveform amplitude becomes ation can't be obtained by trigger		
CH1 INPUT and adjust the oscillator 6 div on the CRT screen. VEL and CH1 ▲▼ POSITION to move ually above and below the horizontal ENSITY to an arbitrary position near tment so that the starting point of position of the starting point of −) position. +) and (−) and make sure that the ntal center graticule line. on, the rise slope of the waveform ope be synchronized at (−). t vertical MODE to CH2 to produce he screen to make sure that the rise ed when B SLOPE is at (+) and the		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjus
Adjustment of B Trigger Level Center	VR2	X77-1290	SG-502	HORIZ DISPLAY: DUAL Vertical MODE: CH1 A, B COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A,B SWEEP TIME/DIV: 0.2ms A VARIABLE: CAL B SOURCE: CH1	(1) Turn B trigger LEVEL knob to (2) Apply a sine wave signal of 1 output to produce a wavefor (3) Operate CH1 ▲▼ POSITION so ly above and below the horiz (4) Turn A INTENSITY to CCW a and make adjustment so that horizontal center graticule lin **<Check>** (1) Turn B SLOPE alternately to point of the waveform is alw (2) With B SLOPE knob remaini knob clockwise toward 3 o' waveform appear as shown (3) Adjust the oscillator output 0.5 div and make sure that operating B trigger LEVEL.
Adjustment of DELAY TIME MULT	VR5 VR6	X74-1350 X74-1350		HORIZ DISPLAY: ALT Vertical MODE: CH1 CH1 AC-GND-DC: GND TRIG MODE: AUTO A SWEEP TIME/DIV: 0.1ms B SWEEP TIME/DIV: 1μs ▲▼ TRACE SEP: NORM STARTS AFTER DELAY: PULL	(1) Set DELAY TIME MULT to 0 (2) Operate A INTENSITY and brighter and A trace light dim (3) Operate ◄► POSITION to b end of the graticule line on t (4) Make adjustment so that B t (5) Next, set DELAY TIME MUL (6) Repeat (1) thru (5) 2 or 3 ti **<Check>** Set DELAY TIME MULT to 5.00 trace is in a position within 5 div

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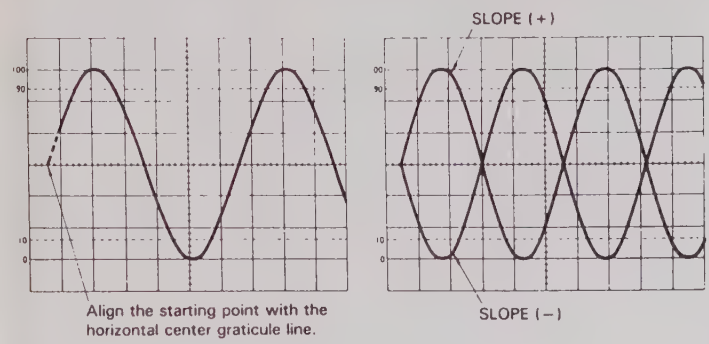
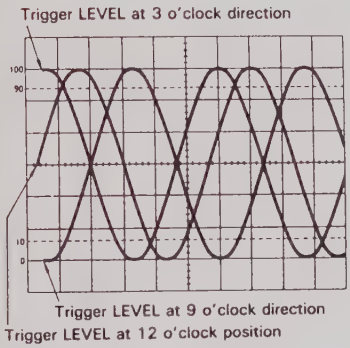
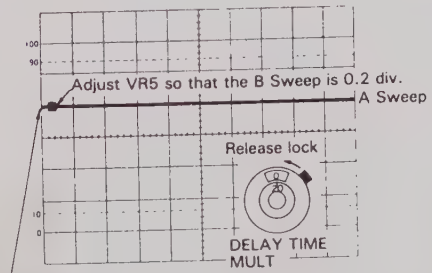
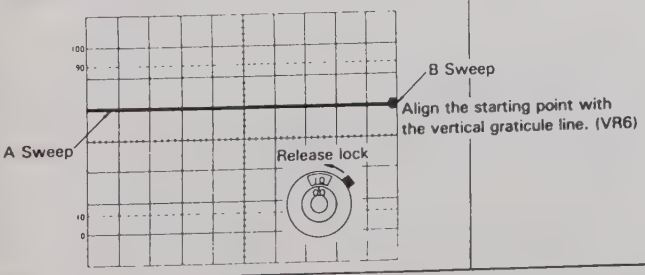
nent and Check	Illustration	Remark
12 o'clock. Hz to CH1 INPUT and adjust the oscillator of 4 ~ 6 div on the CRT screen. hat the waveform has an amplitude equal- ntal center graticule line on the screen. d B INTENSITY to position near 3 o'clock he starting point of the waveform is on the		
+) and (−) and make sure that the starting ys on the horizontal center graticule line. g in the (+) position, turn trigger LEVEL lock from near 9 o'clock and see if the right. o that the waveform amplitude becomes ynchronization is obtained at this time by		
20. B INTENSITY properly to make B trace ner. ng the starting point of A trace to the left e CRT screen. ace may appear as shown at right. to 10.00. es.		
nd make sure that the starting point of B ±0.2 div from the left end of the screen.		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustr
OPERATING CHECKS					
Check of Current CAL			Current probe		Touch a current proble to current C that the calibration current is 1 kH;
Check of Trigger Sensitivity			SG-502 SG-503 475A	Vertical MODE: CH1 CH1 VOLTS/DIV: 5mV A, B SWEEP TIME/DIV: arbitrary position CH1 AC-GND-DC: AC TRIG MODE: NORM	(1) Make measurements of trigge next page. (For both A and B **[I] A Sweep, INT** (1) Set HORIZ DISPLAY to A and (2) Apply a sine wave signal to C operate A trigger LEVEL to amplitude on the CRT screen. TRIG' D lamp is on. Check synchronization by each **[II] B Sweep, INT** (1) Set HORIZ DISPLAY to B DLY' CH1. (2) Apply a sine wave to CH1 INP B trigger LEVEL to measure When doing this, make sure th on. Check synchronization by each **[III] A Sweep, EXT** (1) Set HORIZ DISPLAY to A and (2) Apply a signal of the same vol PUT jacks. (3) Operate CH1 VOLTS/DIV to p screen. (4) Vary the oscillator output and minimum synchronizing amplitu Check synchronization by each When doing this, make sure th **[IV] B Sweep, EXT** (1) Set HORIZ DISPLAY to ALT, A 1/1 or 1/10. (2) Apply a signal of the same vol PUT jacks. (3) Operate CH1 VOLTS/DIV to p screen. (4) Operate B trigger LEVEL and sweep and B sweep. (5) Vary the oscillator output and minimum synchronizing amplit synchronization by each check (6) Make sure that the B TRIG'D la

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ent and Check	Illustration	Remark
AL terminal on the rear panel to make sure ±3% and 10 mA ±2%.		
sensitivity according to the table given sweeps) A SOURCE to CH1. H1 INPUT, vary the oscillator output and measure the minimum synchronizing When doing this, make sure that the A check frequency. D, A SOURCE to CH1 and B SOURCE to UT, vary the oscillator output and operate the minimum synchronizing amplitude. at the A TRIG'D and B TRIG'D lamps are frequency. A SOURCE to EXT 1/1 or 1/10. tage simultaneously to CH1 and CH3 IN- roduce a waveform of 6 div on the CRT operate A trigger LEVEL to measure the de by the oscilloscope (475A). check frequency. at A TRIG'D lamp is on. SOURCE to CH1 and B SOURCE to EXT tage simultaneously to CH1 and CH4 IN- roduce a waveform of 6 div on the CRT A trigger LEVEL to synchronize both A perate B trigger LEVEL and measure the ude by the oscilloscope (475A). Check frequency. mp is on.		

Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting

Adjustr

[V] Check of trigger sensitivity

COUPLING	FREQ. RANGE (Hz)	S V. (CH
AC	20Hz ~ 20MHz ~ 50MHz ~ 100MHz	
DC	DC ~ 20MHz ~ 50MHz ~ 100MHz	
AC HF REJ	1kHz 1MHz	N syn
AC LF REJ	1MHz 1kHz	N syn
VIDEO	VIDEO signal FRAME LINE	

[VI] Check of trigger sensitivity by
HORIZ DISPLAY: A, A SOURCE: A

TRIG MODE	FREQ. RANGE (Hz)	S V (CH
AUTO	30Hz ~ 20MHz ~ 50MHz ~ 100MHz	
FIX	40Hz ~ 20 MHz ~ 80MHz	

[VII] Check of trigger source (A sw

1 TRIG MODE: AUTO, HORIZ D

2 Applied different signals to described below and make su

A SOURCE	
V. MODE	Vertical MODE ~ CH1, sweep Vertical MODE ~ CH2, sweep Vertical MODE ~ DUAL. When the signals of (on one another they sweep of CH1 and C be no synchronizatior Vertical MODE ~ DUAL Vertical MODE ~ ADD Synchronized with the (CH1 — CH2 at CH2 Vertical MODE ~ QUAL When the signals of on one another on th synchronized with th but there will be no s Vertical MODE ~ QUAL
CH1	The signal of CH1 is s
CH2	The signal of CH2 is s
EXT1/1	The signal of CH3 is s
EXT 1/10	The signal of CH3 is a sweep.

3 Check sync by the lighting of

ent and Check	Illustration	Remark

Trig. sensitivity (Min. sync amplitude)		
URCE MODE or CH2)	SOURCE EXT 1/1	SOURCE EXT 1/10
.5div 1div .5div	50mVp-p 100mVp-p 210mVp-p	0.5Vp-p 1Vp-p 2.1Vp-p
.5div 1div .5div	50mVp-p 100mVp-p 210mVp-p	0.5Vp-p 1Vp-p 2.1Vp-p
.5div t to be hronized 1div	50mVp-p Not to be synchronized at 100mVp-p	0.5Vp-p Not to be synchronized at 1Vp-p
.5div t to be hronized 1div	50mVp-p Not to be synchronized at 100mVp-p	0.5Vp-p Not to be synchronized at 1Vp-p
.5div	50mVp-p	0.5Vp-p

TRIG MODE

C

Trig. sensitivity (Min. sync amplitude)		
OURCE MODE or CH2)	SOURCE EXT 1/1	SOURCE EXT 1/10
0.5div 1div 1.5div	50mVp-p 100mVp-p 210mVp-p	0.5Vp-p 1Vp-p 2.1Vp-p
1.0div 1.5div	100mVp-p 210mVp-p	1.0Vp-p 2.1Vp-p

eep)

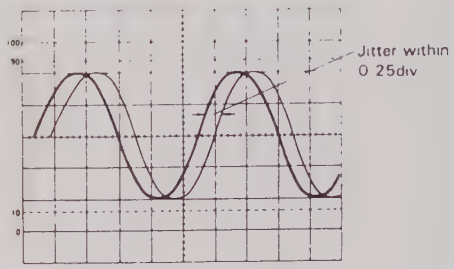
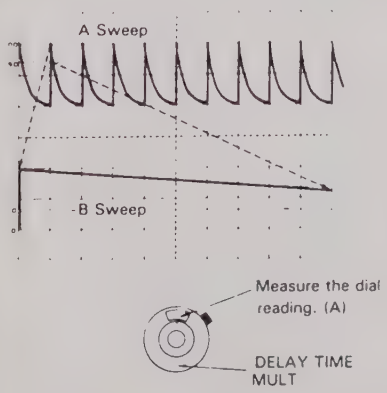
SPLAY: A

CH1 ~ CH4 and operate A SOURCE as e to operate as follow.

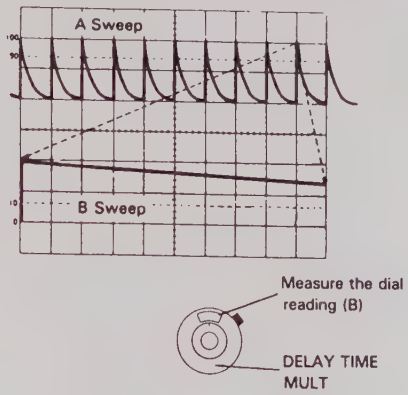
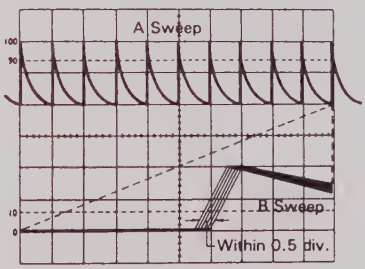
Operation
The signal of CH1 is synchronized with A
The signal of CH2 is synchronized with A
ALT H1 and CH2 are superimposed re synchronized with the A 12, respectively, but there will when there is no signal CHOP, No Sync.
signal of CH2 when CH1 + CH2 INV) , ALT CH1 ~ CH4 are superimposed e CRT screen, the signals will be e A sweep of CH1 ~ CH4 respectively ync when there is no signal. , CHOP, No Sync.
nchronized with A sweep
nchronized with A sweep
nchronized with A sweep
tenuated to 1/10 and synchronized with A

A TRIG'D lamp.

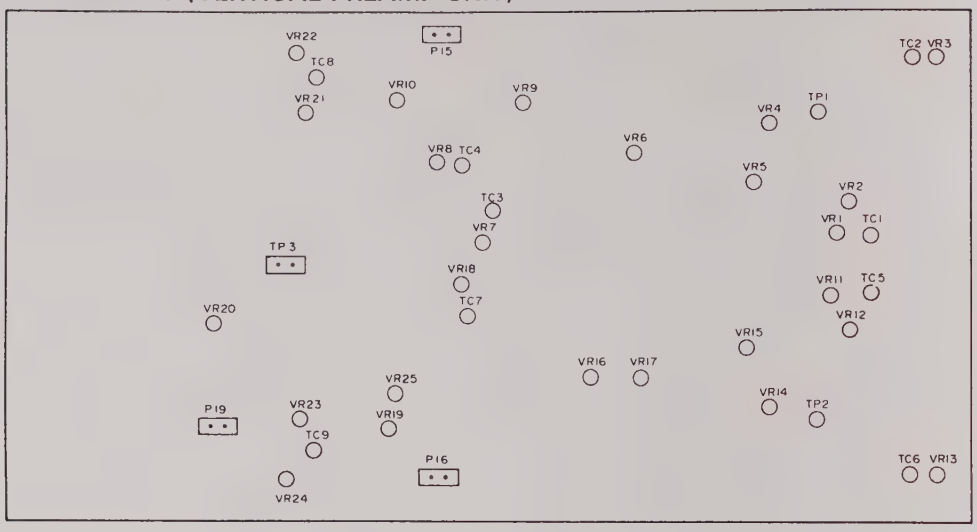
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Adjustme
					[VIII] Check of trigger source (B swe (1) Set HORIZ DISPLAY to A, TRI DUAL, ALT and A SOURCE to V (2) Apply different signals to CH1 signals of CH1 and CH2 on on chronize them by A trigger LEVE (3) Set HORIZ DISPLAY to B DLY'I below to check the synchronizat B SOURCE: CH1 — The signal of CH1 is; CH2 — The signal of CH2 is; EXT 1/1 — The signal of CH4 is; EXT 1/10 — The signal of CH4 is with B sweep. (4) Make sure that the B TRIG'D lar
Check of Jitter			SG503 50Ω Termination	HORIZ DISPLAY: A A SOURCE: CH1 TRIG MODE: NORM A COUPLING: AC A SWEEP TIME/DIV: 20ns CH1 VOLTS/DIV: 0.1V CH1 AC-GND-DC: AC X10 MAG: PULL HOLDOFF: NORM	(1) Apply a sine wave signal of 1(oscillator output to produce a wa (2) Operate A trigger LEVEL to find Jitter — less than 0.25 div
Check of DELAY TIME MULT			TG-501 50Ω Termination	HORIZ DISPLAY: ALT A, B SOURCE: CH1 TRIG MODE: AUTO Vertical MODE: CH1 STARTS AFTER DELAY: PULL CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 1ms B SWEEP TIME/DIV: 5μs	(1) Apply a marker signal of 1 ms to 2 ~ 3 div on the CRT screen. (2) Operate ▲▼ TRACE SEP to separa (3) Operate ◄ ► POSITION to align left end of the screen. (4) Adjust A INTENSITY and B INT positions where they can be eas (5) Operate DELAY TIME MULT so t shown at right (the second pea modulated and should be aligned note the dial reading at this time

nt and Check	Illustration	Remark
ap) G MODE to AUTO, Vertical MODE to MODE. CH2 and CH4 and superimpose the e another on the CRT screen and syn-L.) and operate B SOURCE as described ion. Operation synchronized with B sweep. synchronized with B sweep. synchronized with B sweep. attenuated to 1/10 and synchronized ip is on.		
00 MHz to CH1 INPUT and adjust the veform of 4 div on the CRT screen. a point where the jitter is minimized.		
CH1 INPUT to produce a waveform of e B sweep and A sweep. he first peak of the waveform with the NSITY to bring the waveform into the y visible. hat the patterns of the screen appear as k of the A sweep should be intensity with the left end of B sweep scale) and		<Note> When TG-501 is used, CH1 VOLTS/DIV should be set to 0.5V thru 50Ω termination.

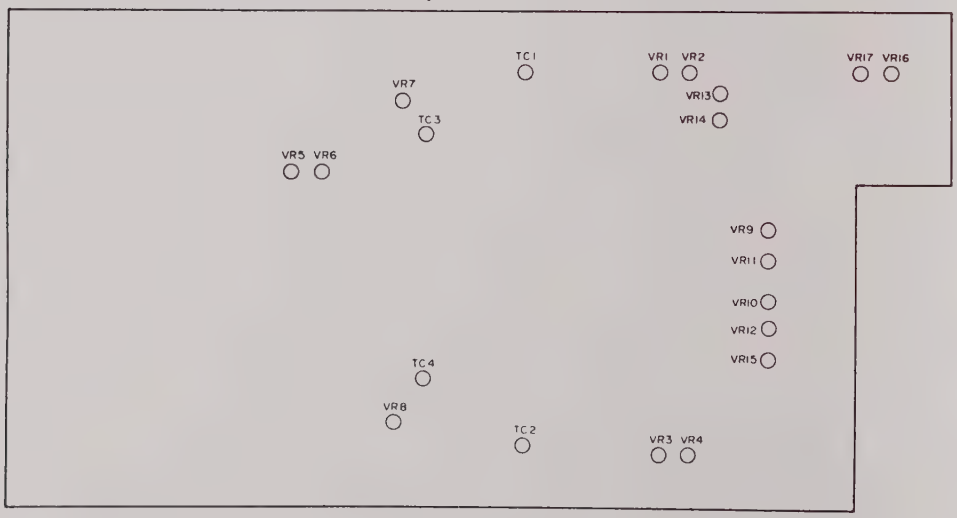
Item	Adjustment Control	P.C.B. No.	Test Equipment	Control Setting	Ad
					(6) Turn DELAY TIME MULT shown at right will happer this time. (7) Make the following calcul the error is within the spe (B) − (A) = 8.00 ± 0.2 Time multiplication error | with
Check of Delay Time Jitter			TG-501 50Ω Termination	HORIZ DISPLAY: ALT A SOURCE: CH1 B SOURCE: CH2 TRIG MODE: AUTO Vertical MODE: CH1 STARTS AFTER DELAY: PULL B ENDS A: ON CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 1ms B SWEEP TIME/DIV: 1μs	(1) Apply a marker signal of 1 2 ~ 3 div on the CRT scre (2) Operate ▲▼ TRACE SEP to (3) Operate DELAY TIME MU (DELAY TIME MULT is to (4) Make sure that the jitter c Specification | less than 1/
Check of BEAM FIND				HORIZ DISPLAY: ALT A SOURCE: CH1 B SOURCE: CH2 TRIG MODE: AUTO Vertical MODE: CH1 STARTS AFTER DELAY: PULL B ENDS A: ON CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 1ms B SWEEP TIME/DIV: 1μs	Make sure that the trace len SWEEP TIME/DIV to each ran

ustment and Check	Illustration	Remark
and operate ◄► POSITION so that what is at the 10th peak and note the dial reading at tion from the dial reading to make sure that ification limits. n ±(1% of measurement +0.1% of full scale)		
ms to CH1 INPUT to produce a waveform of n. separate A sweep and B sweep. LT to obtain the patterns as shown at right. be set to about 10.00). f B sweep is less than 0.5 div at this time. 20,000		
gth is fully covered the screen when rotated ge:		

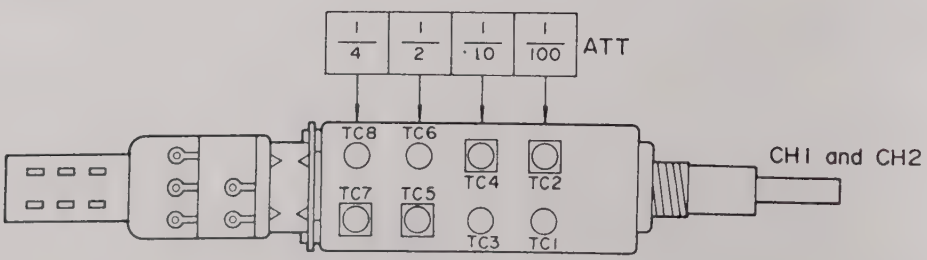
X73-1500-00 (VERTICAL PREAMP UNIT)



X74-1350-00 (TRIG SWEEP UNIT)



VERTICAL ATT.

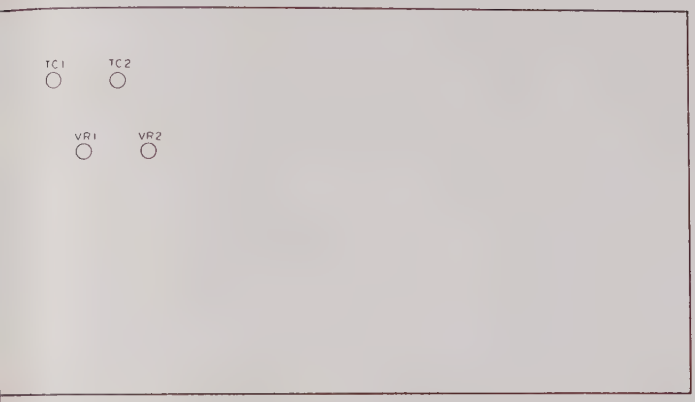


X73-15

X77-12

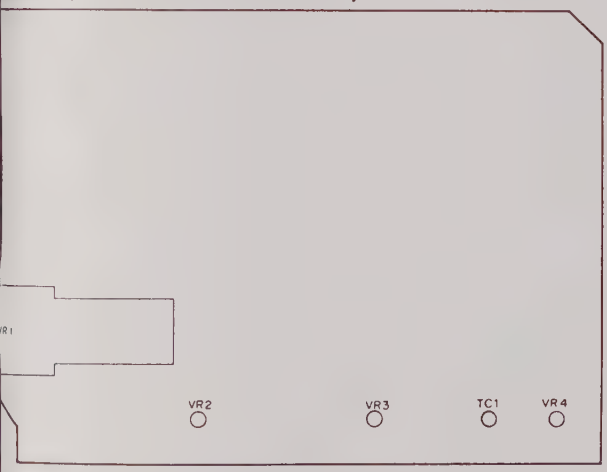
X68-14

10-00 (VERTICAL OUTPUT AMP UNIT)

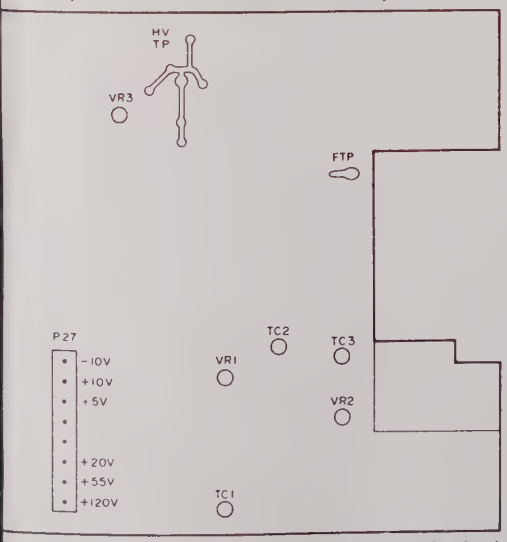


(Component side view)

80-00 (A TRIG SWITCH UNIT)

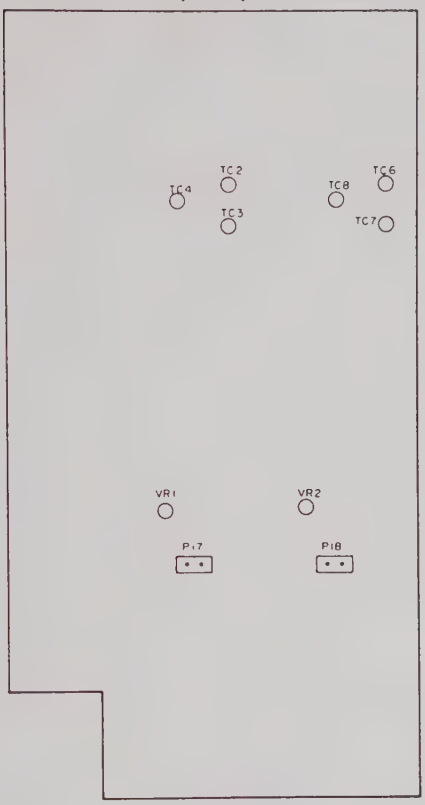


00-00 (POWER BLANKING UNIT)



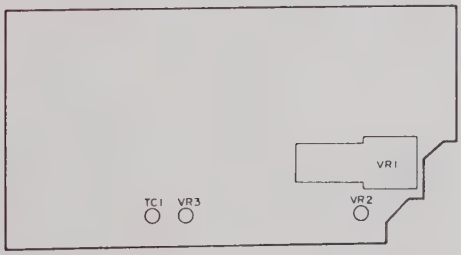
(Component side view)

X73-1520-00 (CH3, CH4 AMP UNIT)



(Component side view)

X77-1290-00 (B TRIG SWITCH UNIT)



X81-1430-00 (ASTIG UNIT)

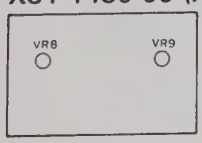
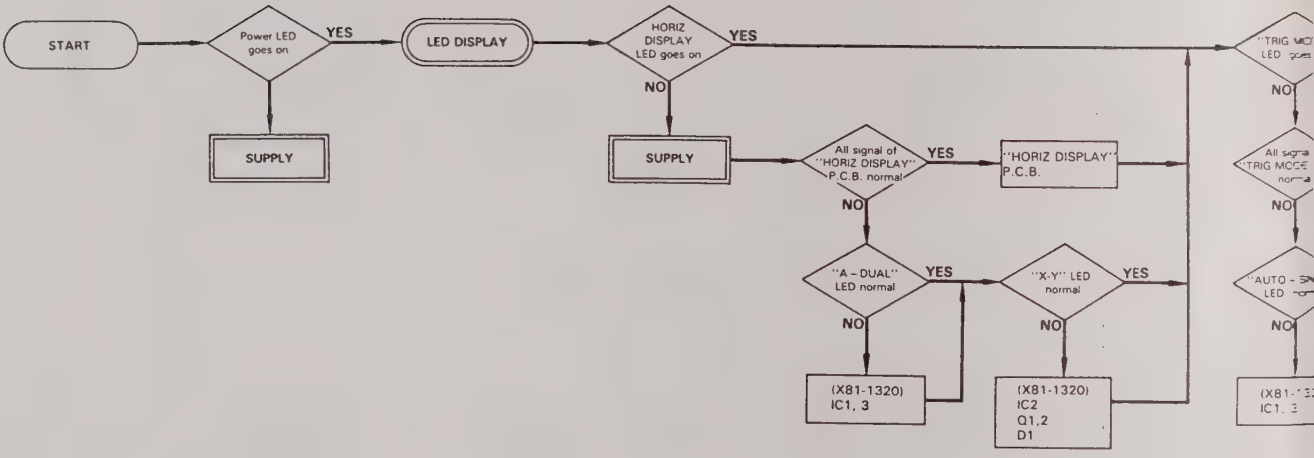
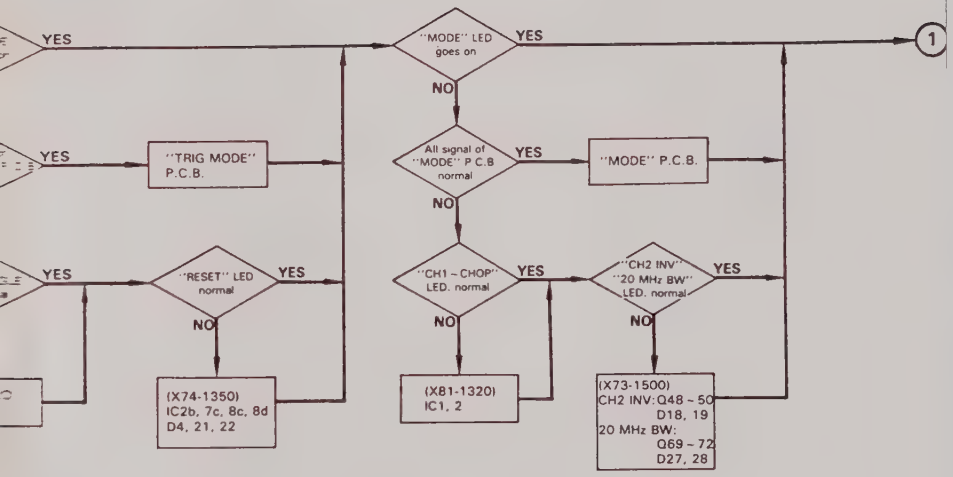


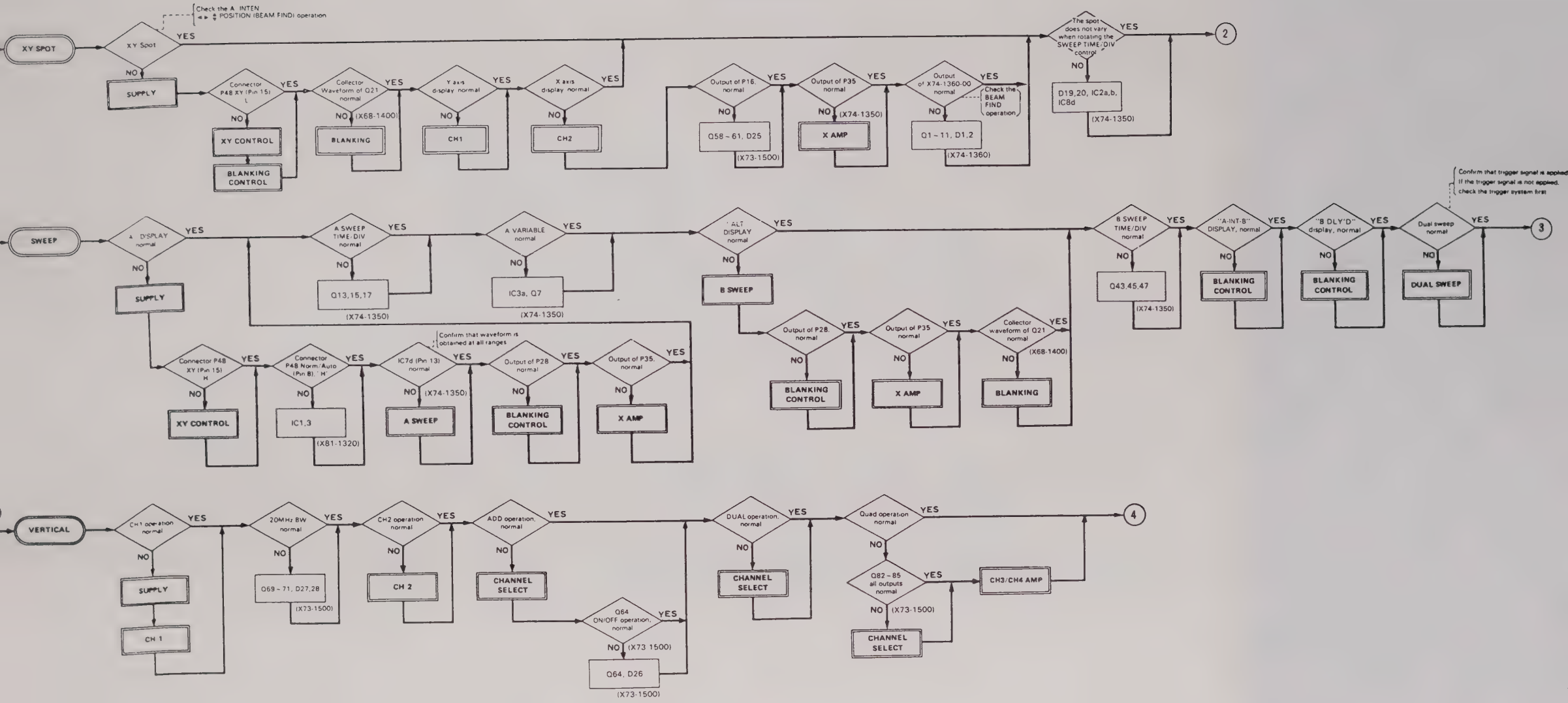
Fig. 6 LOCATION OF ADJ. CONTROLS

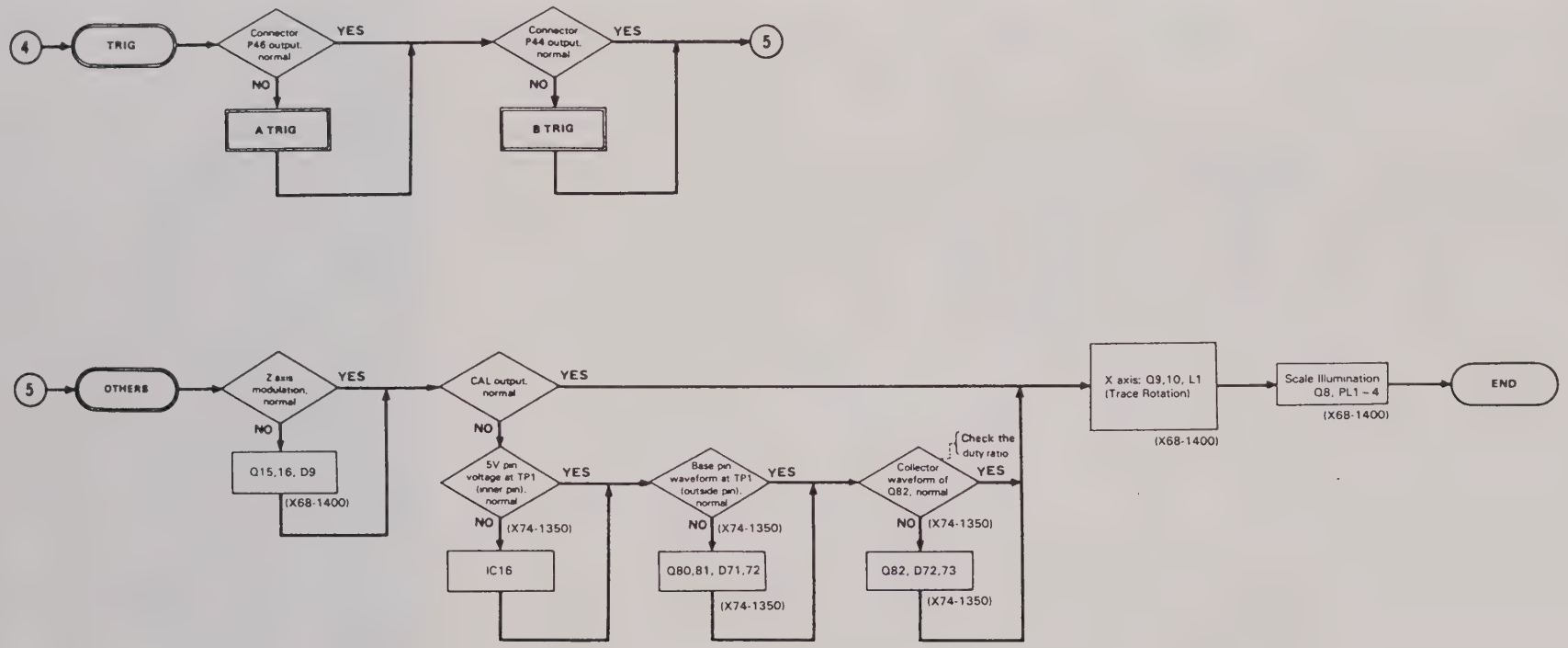

START
Power LED goes on
YES
SUPPLY
LED DISPLAY
HORIZ DISPLAY LED goes on
YES
NO
SUPPLY
All signal of "HORIZ DISPLAY" P.C.B. normal
YES
"HORIZ DISPLAY" P.C.B.
NO
"A – DUAL" LED normal
YES
NO
(X81-1320) IC1, 3
"X-Y" LED normal
YES
NO
(X81-1320) IC2 Q1,2 D1
"TRIG MO
LED goes
NO
All signa
"TRIG MODE
norma
NO
"AUTO - SN
LED
NO
(X81-"3
IC1, 3

TING


YES
"MODE" LED goes on
YES
1
NO
YES
"TRIG MODE" P.C.B.
All signal of "MODE" P.C.B normal
YES
"MODE" P.C.B.
NO
YES
"RESET" LED normal
YES
"CH1 – CHOP" LED. normal
YES
"CH2 INV" "20 MHz BW" LED. normal
YES
NO
NO
NO
(X74-1350)
IC2b, 7c, 8c, 8d
D4, 21, 22
(X81-1320)
IC1, 2
(X73-1500)
CH2 INV: Q48 ~ 50
D18, 19
20 MHz BW:
Q69 ~ 72
D27, 28

TROUBLESHOOTING





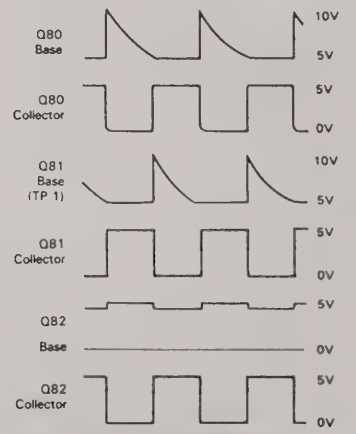
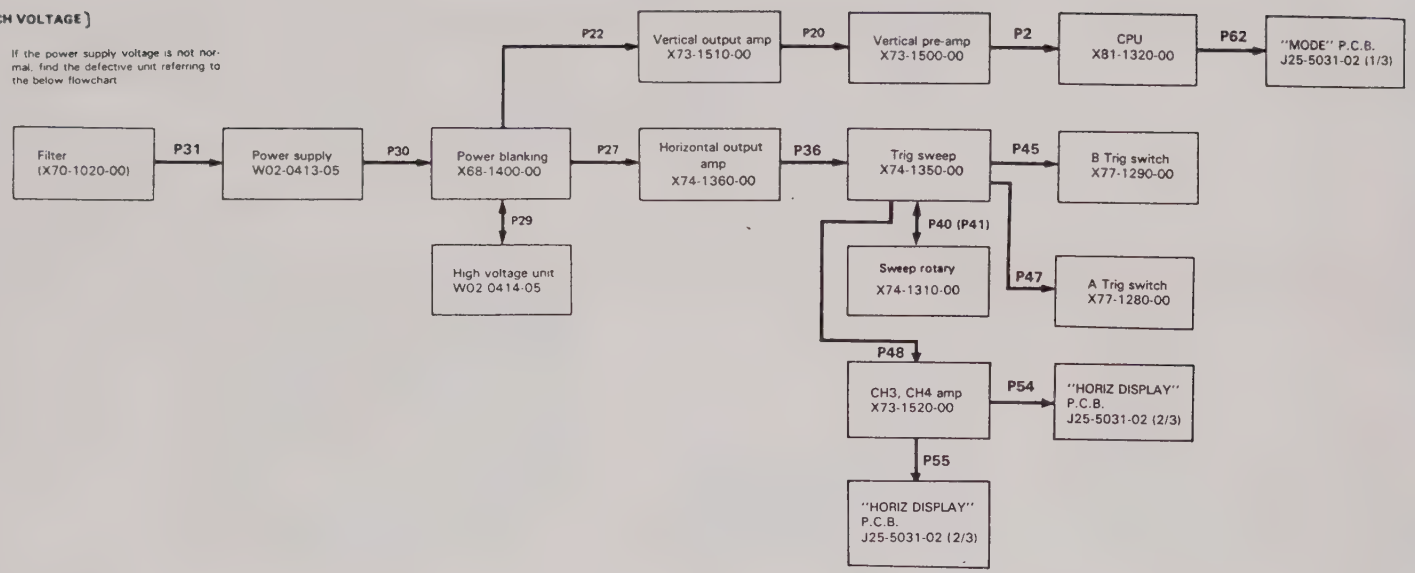


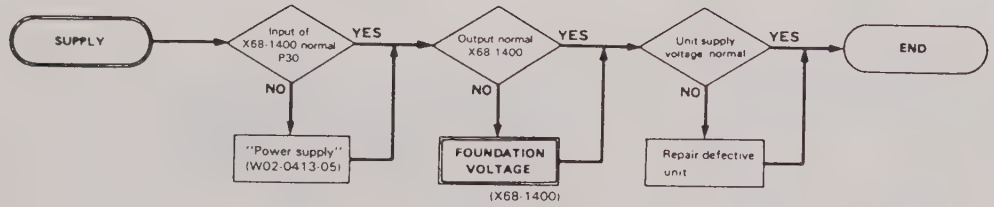
Fig. 7 CAL CIRCUIT WAVEFORMS

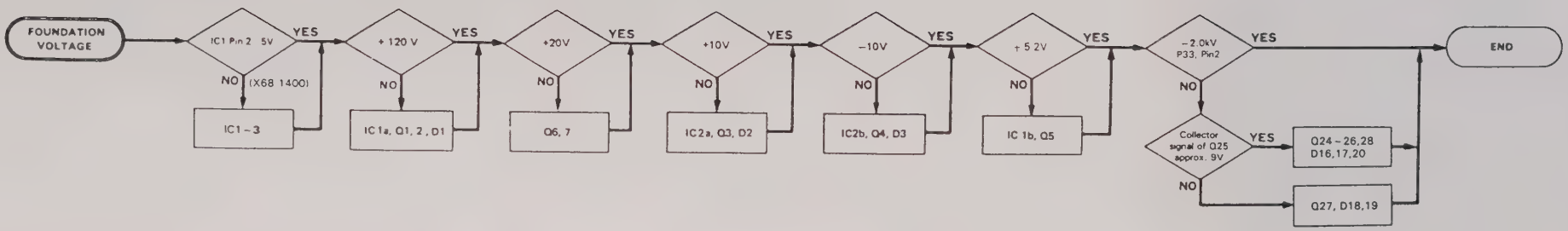
TROUBLESHOOTING

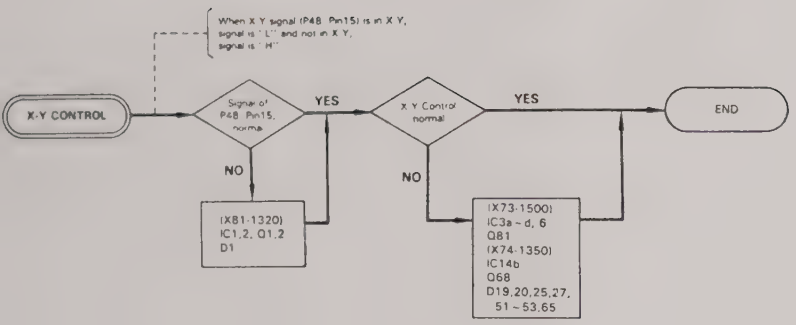
(POWER SUPPLY OF EACH VOLTAGE)

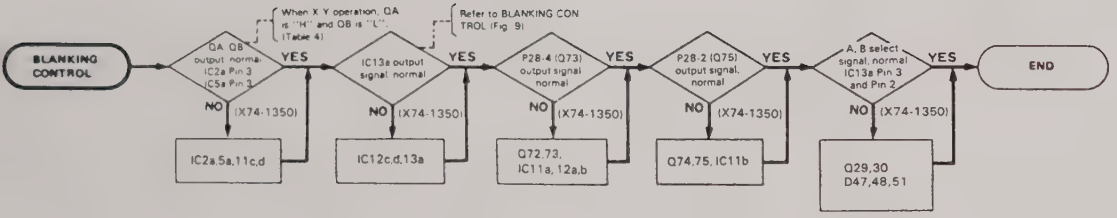
If the power supply voltage is not normal, find the defective unit referring to the below flowchart

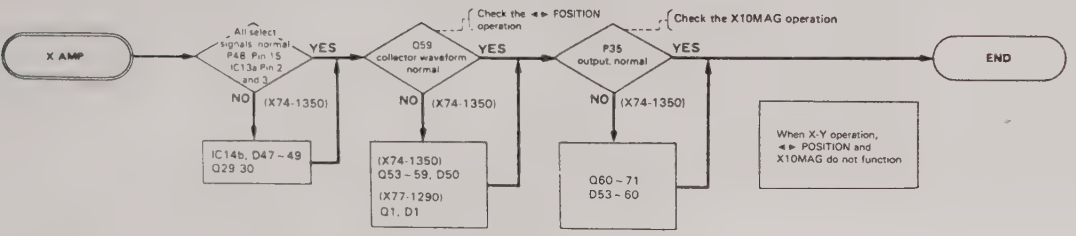




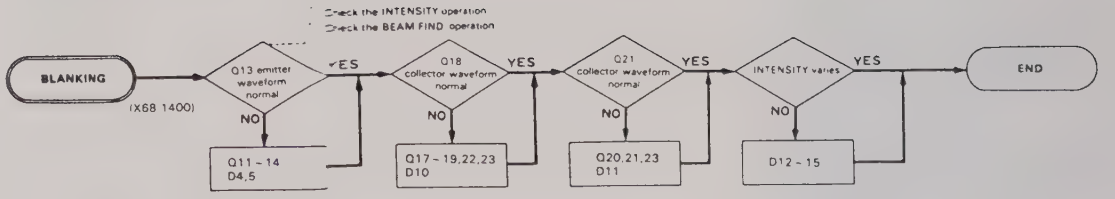








TROUBLESHOOTING



BLANKING CONTROL

HORIZ DISPLAY	P48 X-Y BUFFER 15Pin	IC13a IN S	IC13a IN R	IC13a OUT Q	IC13a OUT $\overline{Q}$	IC12d OUT	P28 A blanking 4 Pin	P28 B blanking 2 Pin
A	H	H	L	H	-	H	QA	H
ALT	H	L	L	TOGGLE		H	QA*	QB
A-INT-B	H	H	L	H	-	H	QA	QB
B-DLY'D	H	L	H	L	-	H	H	QB
DUAL	H	L	L	TOGGLE		TOGGLE	QA*	QB*
X-Y	L	H	L	H	-	H	L	H

Complex waveform IC11b output. When CHOP operation, output of P28 is complex CHOP signal waveform.

Table 4

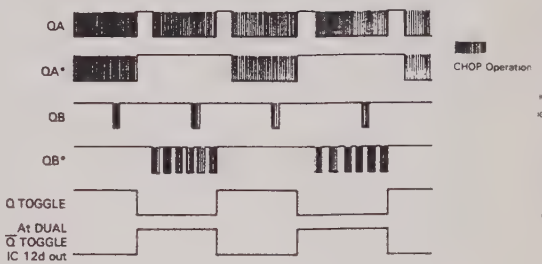


Fig. 8 RELATIONSHIP BETWEEN A, B SWEEP AND QA, QB

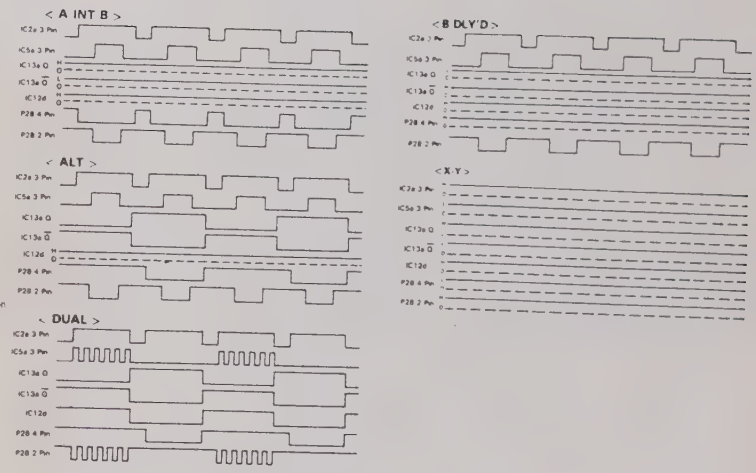
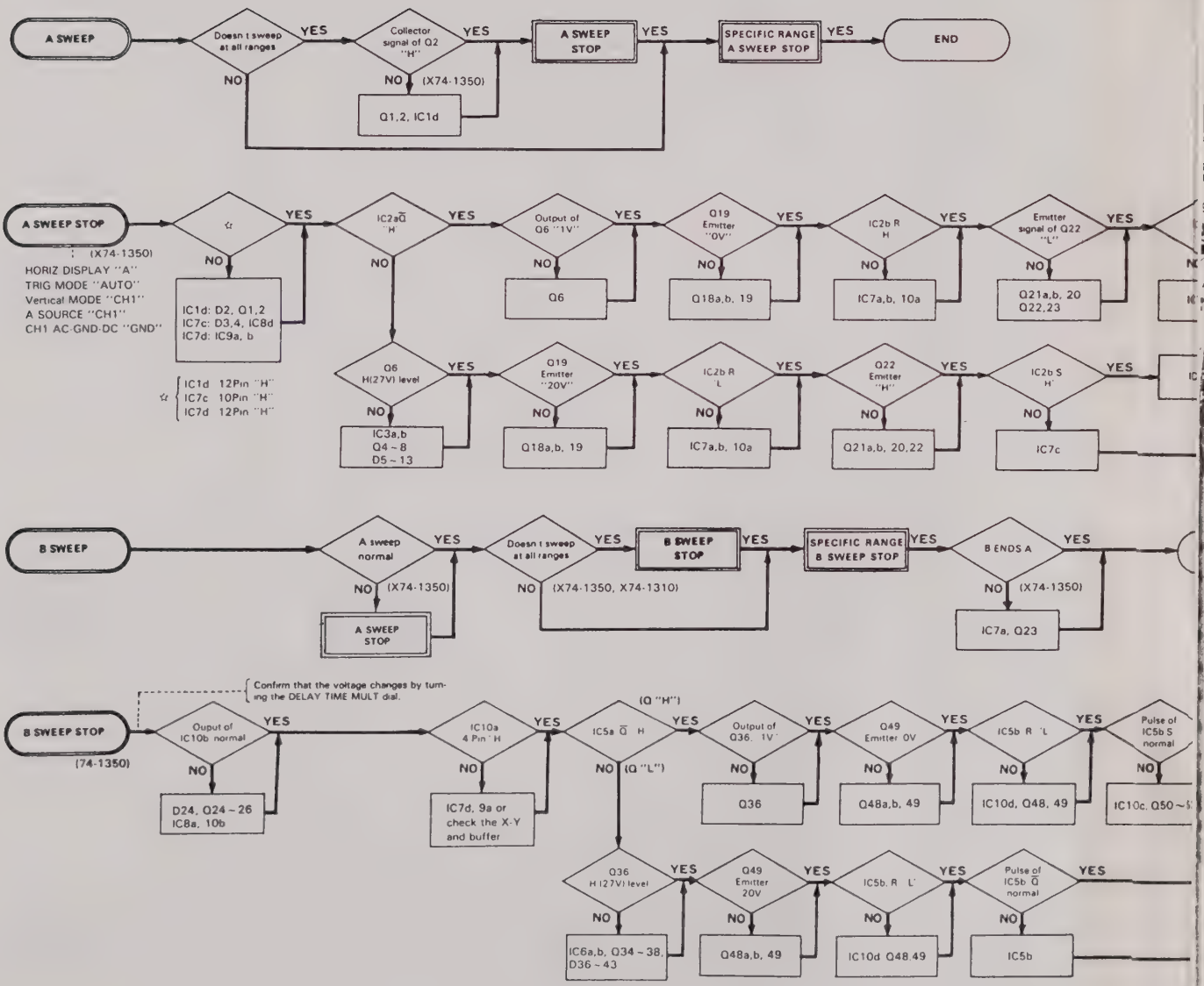
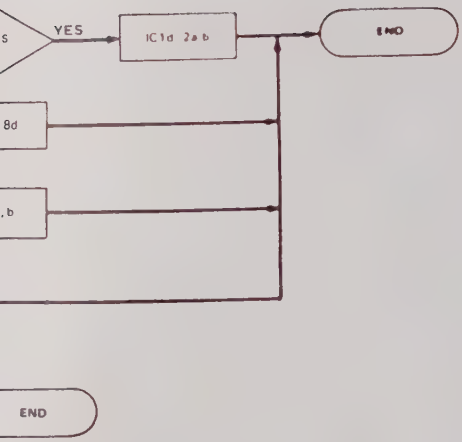
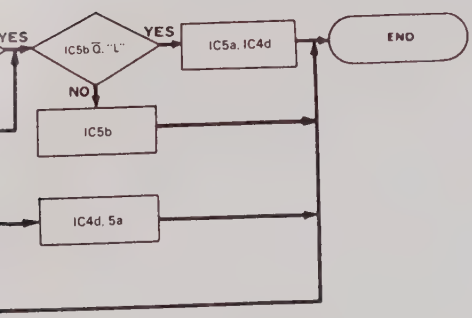
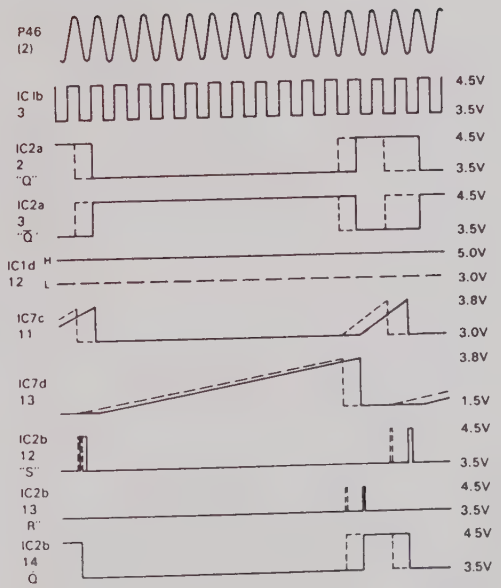


Fig. 9 BLANKING CONTROL


A SWEEP
Doesn t sweep at all ranges
YES
NO
Collector signal of Q2 "H"
YES
NO (X74-1350)
Q1,2, IC1d
A SWEEP STOP
YES
SPECIFIC RANGE A SWEEP STOP
YES
END
A SWEEP STOP
(X74-1350)
HORIZ DISPLAY "A"
TRIG MODE "AUTO"
Vertical MODE "CH1"
A SOURCE "CH1"
CH1 AC-GND-DC "GND"
☆
IC1d: D2, Q1,2
IC7c: D3,4, IC8d
IC7d: IC9a, b
☆ IC1d 12Pin "H"
IC7c 10Pin "H"
IC7d 12Pin "H"
IC2a Q̄ "H"
Output of Q6 "1V"
Q19 Emitter "0V"
IC2b R H
Emitter signal of Q22 "L"
Q6
Q18a,b, 19
IC7a,b, 10a
Q21a,b, 20 Q22,23
Q6 H(27V) level
Q19 Emitter "20V"
IC2b R L
Q22 Emitter "H"
IC2b S H
IC3a,b Q4 ~ 8 D5 ~ 13
Q18a,b, 19
IC7a,b, 10a
Q21a,b, 20,22
IC7c
B SWEEP
A sweep normal
(X74-1350)
A SWEEP STOP
Doesn t sweep at all ranges
(X74-1350, X74-1310)
B SWEEP STOP
SPECIFIC RANGE B SWEEP STOP
B ENDS A
(X74-1350)
IC7a, Q23
B SWEEP STOP
(74-1350)
Confirm that the voltage changes by turning the DELAY TIME MULT dial.
Ouput of IC10b normal
D24, Q24 ~ 26 IC8a, 10b
IC10a 4 Pin "H"
IC7d, 9a or check the X-Y and buffer
IC5a Q̄ H (Q "H")
(Q "L")
Output of Q36, 1V
Q36
Q49 Emitter 0V
Q48a,b, 49
IC5b R "L"
IC10d, Q48, 49
Pulse of IC5b S normal
IC10c, Q50 ~
Q36 H (27V) level
IC6a,b, Q34 ~ 38, D36 ~ 43
Q49 Emitter 20V
Q48a,b, 49
IC5b R L
IC10d Q48,49
Pulse of IC5b Q̄ normal
IC5b

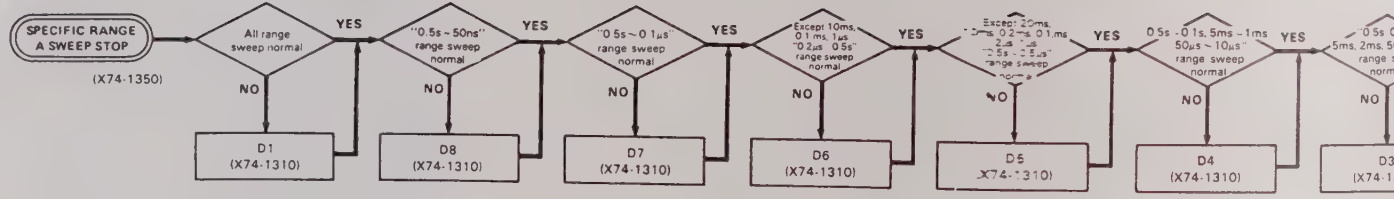


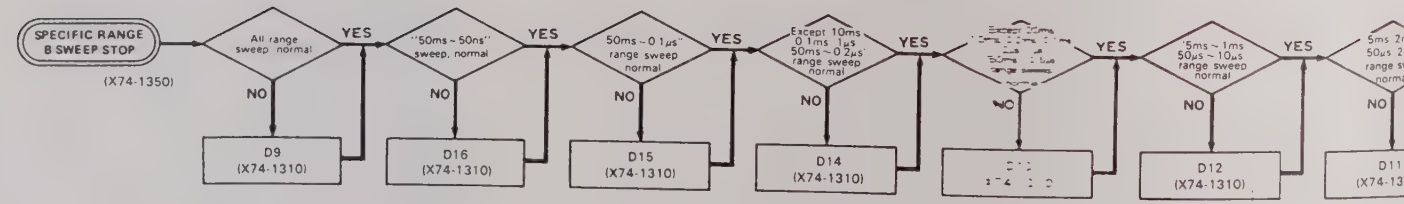


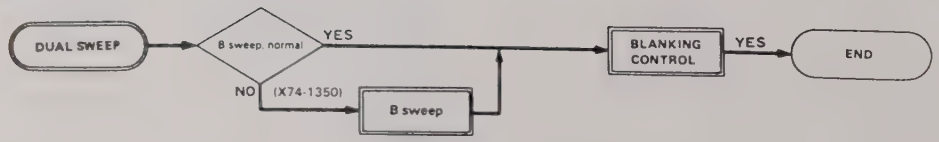


Note: Broke-line auto free run (at non-signal)

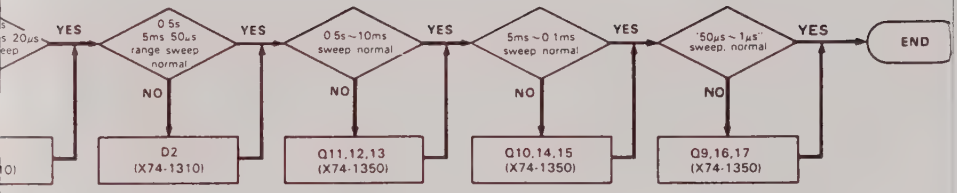
Fig. 10 Waveform in Sweep circuit (X74-1350-00)
(Input signal 1 kHz, SWEEP TIME 1 ms/div)

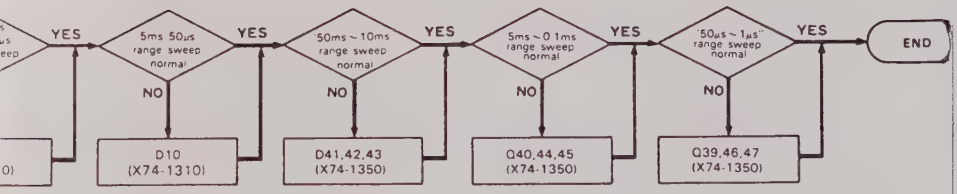

SPECIFIC RANGE A SWEEP STOP
(X74-1350)
All range sweep normal
YES
NO
D1 (X74-1310)
"0.5s ~ 50ns" range sweep normal
YES
NO
D8 (X74-1310)
"0.5s ~ 0.1μs" range sweep normal
YES
NO
D7 (X74-1310)
Except 10ms, 0.1ms, 1μs "0.2μs 0.5s" range sweep normal
YES
NO
D6 (X74-1310)
YES
NO
YES
0.5s - 0.1s, 5ms ~ 1ms 50μs ~ 10μs" range sweep normal
YES
NO
D4 (X74-1310)
YES
NO


SPECIFIC RANGE B SWEEP STOP
(X74-1350)
All range sweep normal
YES
NO
D9 (X74-1310)
"50ms ~ 50ns" sweep, normal
YES
NO
D16 (X74-1310)
50ms ~ 0.1μs" range sweep normal
YES
NO
D15 (X74-1310)
Except 10ms 0.1ms 1μs 50ms ~ 0.2μs range sweep normal
YES
NO
D14 (X74-1310)
YES
NO
YES
5ms ~ 1ms 50μs ~ 10μs range sweep normal
YES
NO
D12 (X74-1310)
YES
NO


DUAL SWEEP
B sweep, normal
YES
NO
(X74-1350)
B sweep
BLANKING CONTROL
YES
END

OTING


YES
0.5s
5ms 50μs
range sweep
normal
YES
0.5s~10ms
sweep normal
YES
5ms~0.1ms
sweep normal
YES
"50μs~1μs"
sweep, normal
YES
END
NO
D2
(X74-1310)
NO
Q11,12,13
(X74-1350)
NO
Q10,14,15
(X74-1350)
NO
Q9,16,17
(X74-1350)


YES
5ms 50μs
range sweep
normal
YES
50ms~10ms
range sweep
normal
YES
5ms~0.1ms
range sweep
normal
YES
"50μs~1μs"
range sweep
normal
YES
END
NO
D10
(X74-1310)
NO
D41,42,43
(X74-1350)
NO
Q40,44,45
(X74-1350)
NO
Q39,46,47
(X74-1350)

ELECTRICAL PARTS LIST

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	MAIN CHASSIS (Y70-1461-61)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.	
VR1, 2	Dual 1 kΩ Potentiometer, CH 1/CH 3 or CH 2/CH 4 POSITON Control	008-482-9-001
VR3, 4	Part of VERTICAL ATTENUATOR UNIT, CH 1 or CH 2 VARIABLE Controls	
VR5	Dual 5 kΩ Potentiometer with rotary switch, TRACE SEP/HOLDOFF Control	008-406-9-003
VR6	Dual 5 kΩ Potentiometer with push/pull switch, HORIZONTAL POSITION Control	008-406-9-002
VR7	1 kΩ Potentiometer, DELAY TIME MULT Control	008-406-9-004
	CAPACITORS	
C1, 2	0.047 µF ±10%, 630 V, Metal Film	033-042-9-003
C3, 4	0.01 µF,3 kV, Ceramic	033-077-9-001
	INDICATORS	
D1	LED, Red, CH 1 UNCAL Indicator	158-039-9-001
D2	LED, Green, CH 1 X5 GAIN Indicator	158-039-9-002
D3	LED, Red, CH 2 UNCAL Indicator	158-039-9-001
D4	LED, Green, CH 2 X5 GAIN Indicator	158-039-9-002
D5, 6	LED, Green, A TRIG'D, B TRIG'D Indicator	158-039-9-002
D7	LED, Red, A SWEEP UNCAL Indicator	158-039-9-001
D8	LED, Red, POWER Indicator	400-072-9-001
	SWITCHES	
S1-19	Pushbutton Switch Vertical MODE, HORIZ MODE, TRIG MODE, 20 MHz BW, CH 2 INV (19 used)	088-069-9-002
S20	Pushbutton Switch BEAM FIND	088-069-9-003
S21, 22	Part of VERTICAL ATTENUATOR UNIT	
S23, 24	Lever Switch, CH 1 or CH 2 INPUT COUPLING SWITCH	080-015-9-001
S25	Rotary Switch, B ENDS A Control, Part of VR5	
S26	Push Switch, PULL X10 MAG Control, Part of VR6	
S27, 28	Rotary Switch, CAL Control, Part of VERTICAL ATTENUATOR UNIT	
	VERTICAL ATTENUATOR UNIT	083-301-9-001
	MISCELLANEOUS	
CRT	150KTM31 Cathode Ray Tube	230-027-9-001
	CRT Socket	749-088-9-001
L1	Y Alignment Coil	041-148-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
L2	Delay Line	040-006-9-001
	BNC Receptacle, CH 1 OUT, SWEEP OUT, etc.	773-090-9-001
	Fuse, 1.2 A	191-017-9-001
	Fuse Holder	742-029-9-001
	CAL Terminal	345-059-9-001
	GND Terminal	345-065-9-001
	CURRENT Terminal	345-066-9-001
	UL-CSA Power Cord	420-030-9-001
	Insulator (for blanking)	342-082-9-004
	Insulator (for battery)	342-116-9-001
	Switching Power Supply (W02-0413-05)	157-028-9-001
	High Voltage Block (W02-0414-05)	157-028-9-002
	Lithium Battery, 3V, 0.2 AH	213-008-9-001

ASTIG UNIT
(X81-1430-00)

VR8	10 kΩ Potentiometer, TRACE ROTATION Control	008-482-9-004
VR9	150 kΩ Potentiometer, ASTIG Control	008-482-9-005

FILTER UNIT
(X70-1020-00)

RESISTORS

R1	220 kΩ ±5%, 1/2 W Carbon Film	002-102-5-224
R2	2.2 MΩ ±5%, 1/2 W Solid	002-102-5-225

CAPACITORS

C1	0.22 µF ±10%, 630 V, Polyester	033-077-9-002
C2, 3	1000 pF, 630 V, Ceramic	033-077-9-003
C4	1 µF ±20%, 50V, Electrolytic	022-226-9-017

MISCELLANEOUS

L1	Choke Coil	041-148-9-002
D1	GMA-01, Diode	151-111-9-001
IC1	ON3101, Photo Coupler	307-355-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C43	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C44	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C45	68 pF ±5%, 100 V, Mica	023-079-9-001
C46, 47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	4700 pF ±10%, 50 V, Ceramic	020-302-9-001
C49	Not Used	
C50-55	0.01 µF, 50 V, Ceramic	020-341-9-003
C56, 57	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
C58-61	0.01 µF, 50 V, Ceramic	020-341-9-003
C62	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C63	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
C64	12 pF ±5%, 50 V, Ceramic	020-167-9-002
C65-67	0.01 µF, 50 V, Ceramic	020-341-9-003
C68	47 pF ±5%, 50 V, Ceramic	020-144-9-004
C69, 70	0.01 µF, 50 V, Ceramic	020-341-9-003
C71, 72	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
C73, 74	10 pF ±0.5pF, 50 V, Ceramic	020-215-9-001
C75, 76	150 pF ±5%, 50 V, Ceramic	020-171-9-008
C77	0.01 µF, 50 V, Ceramic	020-341-9-003
C78, 79	Not Used	
C80-82	0.01 µF, 50 V, Ceramic	020-341-9-003
C83	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C84, 85	0.01 µF, 50 V, Ceramic	020-341-9-003
C86	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C87	0.01 µF, 50 V, Ceramic	020-341-9-003
C88-97	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C98	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C99	0.01 µF, 50 V, Ceramic	020-341-9-003
C100	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C101, 102	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C103-109	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C110	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C111	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C112, 113	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C114-118	0.01 µF, 50 V, Ceramic	020-341-9-003
C119	Not Used	
C120	0.01 µF, 50 V, Ceramic	020-341-9-003
C121, 122	220 pF ±5%, 50 V, Ceramic	020-283-9-008
C123, 124	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C125, 126	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C127	1 pF ±0.25pF, 50 V, Ceramic	020-250-9-001
C128	0.01 µF, 50 V, Ceramic	020-341-9-003
C129	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
TC1	20 pF, Trimmer Capacitor	028-057-9-001
TC2, 3	10 pF, Trimmer Capacitor	028-054-9-001
TC4, 5	20 pF, Trimmer Capacitor	028-057-9-001
TC6-9	10 pF, Trimmer Capacitor	028-054-9-001
	INDUCTORS	
L1-10	4.7 µH, Ferrite	041-068-9-008
L11	100 µH, Ferrite	041-133-9-004
L12-18	4.7 µH, Ferrite	041-068-9-008
L19	Not Used	

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
L20-23	4.7 µH, Ferrite	041-068-9-008
	DIODES	
D1, 2	1S1544A	151-096-9-001
D3	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D4-10	GMA-01	151-111-9-001
D11, 12	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D13, 14	1S1544A	151-096-9-001
D15	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D16, 17	GMA-01	151-111-9-001
D18	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D19	1N60, Germanium	150-001-9-005
D20-24	GMA-01	151-111-9-001
D25	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D26	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D27	GMA-01	151-111-9-001
D28	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D29-46	GMA-01	151-111-9-001
	TRANSISTORS	
Q1	J304, N-Channel FET	182-076-9-002
Q2-5	2SC2671(H), NPN Silicon	176-157-9-006
Q6, 7	2SC3354(T,S), NPN Silicon	176-157-9-004
Q8	2SC1733, NPN Silicon	176-157-9-005
Q9-13	2SC3315(C,D), NPN Silicon	176-157-9-003
Q14	2SC3311(R), NPN Silicon	176-157-9-002
Q15, 16	2SA1161, PNP Silicon	177-048-9-003
Q17	2SC3311(R), NPN Silicon	176-157-9-002
Q18, 19	2SA1323(B), PNP Silicon	177-071-9-002
Q20, 21	2SC3315(C,D), NPN Silicon	176-157-9-003
Q22-25	2SC2671(H), NPN Silicon	176-157-9-006
Q26, 27	2SC3315(C,D), NPN Silicon	176-157-9-003
Q28, 29	2SC3354(T,S), NPN Silicon	176-157-9-004
Q30	J304, N-Channel FET	182-076-9-002
Q31-34	2SC2671, NPN Silicon	176-157-9-006
Q35, 36	2SC3354(T,S), NPN Silicon	176-157-9-004
Q37	2SC1733, NPN Silicon	176-157-9-005
Q38-42	2SC3315(C,D), NPN Silicon	176-157-9-003
Q43	2SC3311, NPN Silicon	176-157-9-002
Q44-47	2SA1161, PNP Silicon	177-048-9-003
Q48	2SC3311(R), NPN Silicon	176-157-9-002
Q49, 50	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q51	2SC3311(R), NPN Silicon	176-157-9-002
Q52, 53	2SA1323(B), PNP Silicon	177-071-9-002
Q54, 55	2SC3315(C,D), NPN Silicon	176-157-9-003
Q56-59	2SC2671(H), NPN Silicon	176-157-9-006
Q60	2SC3315(C,D), NPN Silicon	176-157-9-003
Q61-63	2SC3354(T,S), NPN Silicon	176-157-9-004
Q64	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q65, 66	2SC3354(T,S), NPN Silicon	176-157-9-004
Q67, 68	2SA1161, PNP Silicon	177-048-9-003
Q69, 70	2SC3315(C,D), NPN Silicon	176-157-9-003
Q71	2SA1309(Q,R), PNP Silicon	177-071-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q72	2SC3311(R), NPN Silicon	176-157-9-002
Q73, 74	2SA1161, PNP Silicon	177-048-9-003
Q75	2SC3311(R), NPN Silicon	176-157-9-002
Q76, 77	2SC2671(H), NPN Silicon	176-157-9-006
Q78	2SC3311(R), NPN Silicon	176-157-9-002
Q79, 80	2SC2671(H), NPN Silicon	176-157-9-006
Q81	2SC3311(R), NPN Silicon	176-157-9-002
Q82 -85	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q86, 87	2SC3311(R), NPN Silicon	176-157-9-002
	INTEGRATED CIRCUITS	
IC1, 2	LF441ACN, Low Power JFET Op-Amp	307-355-9-003
IC3	SN7400N, Quad 2-input NAND Gate	307-106-9-004
IC4	MC10104L, Quad 2-input AND Gate	307-309-9-004
IC5	MC10131L, Dual D FLIP FLOP	307-309-9-005
IC6, 7	MC10102L, Quad 2-input NOR Gate	307-301-9-001
IC8	LM337LZ, Regulator	307-355-9-005
IC9	LM317LZ, Regulator	307-355-9-004

CHANNEL 3 AND 4 AMPLIFIER UNIT
(X73-1520-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.

R2	900 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-005
R3	111 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-004
R6	1 MΩ ±0.5%, 1/4 W, Metal Film	013-086-9-003
R16, 17	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R18, 19	1.1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-101
R20	680 Ω ±1%, 1/6 W, Metal Film	013-085-9-020
R21, 22	360 Ω ±1%, 1/6 W, Metal Film	013-085-9-027
R33	900 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-005
R34	111 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-004
R37	1 MΩ ±0.5%, 1/4 W, Metal Film	013-086-9-003
R47, 48	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R49, 50	1.1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-101
R51	680 Ω ±1%, 1/6 W, Metal Film	013-085-9-020
R52, 53	360 Ω ±1%, 1/6 W, Metal Film	013-085-9-027
VR1, 2	100 Ω Trimpot	008-434-9-002
	CAPACITORS	
C1	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C2, 3	0.01 µF, 50 V, Ceramic	020-341-9-003
C4	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C5	100 pF ±5%, 50 V, Ceramic	020-341-9-005
C6	5 pF ±0.25 pF, 50 V, Ceramic	020-233-9-002
C7	Not Used	
C8	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C9, 10	0.01 µF, 50 V, Ceramic	020-341-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C11	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C12	100 pF ±5%, 50 V, Ceramic	020-341-9-005
C13	5 pF ±0.25 pF, 50 V, Ceramic	020-233-9-002
C14	Not Used	
C15-17	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C18 -23	0.01 µF, 50 V, Ceramic	020-341-9-003
C24, 25	Not Used	
C26-31	0.01 µF, 50 V, Ceramic	020-341-9-003
C32, 33	Not Used	
C34, 35	22 pF ±5%, 50 V, Ceramic	020-215-9-002
TC1	Not Used	
TC2	6 pF, Trimmer Capacitor	028-065-9-003
TC3	10 pF, Trimmer Capacitor	028-054-9-001
TC4	20 pF, Trimmer Capacitor	028-057-9-001
TC5	Not Used	
TC6	6 pF, Trimmer Capacitor	028-065-9-003
TC7	10 pF, Trimmer Capacitor	028-054-9-001
TC8	20 pF, Trimmer Capacitor	028-057-9-001
	INDUCTORS	
L1-3	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	GMA-01	151-111-9-001
D2	1S1544A	151-096-9-001
D3	GMA-01	151-111-9-001
D4	1S1544A	151-096-9-001
D5-9	GMA-01	151-111-9-001
	TRANSISTORS	
Q1	2SD438F, NPN Silicon	172-058-9-002
Q2	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q3, 4	2SC3354(T,S), NPN Silicon	176-157-9-004
Q5, 6	2SA1206, PNP Silicon	177-071-9-003
Q7, 8	2SC2671(H), NPN Silicon	176-157-9-006
Q9	2SD438(F), NPN Silicon	172-058-9-002
Q10	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q11, 12	2SC3354(T,S), NPN Silicon	176-157-9-004
Q13, 14	2SA1206, PNP Silicon	177-071-9-003
Q15, 16	2SC2671(H), NPN Silicon	176-157-9-006
	RELAYS	
RL1, 2	DPDT Relay	441-041-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	VERTICAL OUTPUT AMPLIFIER UNIT (X73-1510-00)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.	
R1	200 Ω ±1%, 1/6 W, Metal Film	015-164-2-000
R5, 6	75.0 Ω ±1%, 1/6 W, Metal Film	015-164-7-508
R10, 11	390 Ω ±1%, 1/4 W, Metal Film	013-076-9-001
R24, 25	68.0 Ω ±1%, 1/4 W, Metal Film	013-034-9-028
R31,32	560 Ω ±5%, 5 W, Metal Film	011-005-5-561
R37, 38	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R39	330 Ω ±1%, 1/6 W, Metal Film	013-085-9-014
R40	2 kΩ ±1%, 1/6 W, Metal Film	015-164-2-001
R41	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R43	47.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-024
R45	47.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-024
R46	91.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-026
R47	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R48	2.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-023
VR1-3	500 Ω Trimpot	008-467-9-005
	CAPACITORS	
C1	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C2, 3	0.01 µF, 50 V, Ceramic	020-341-9-003
C4	220 pF ±5%, 50 V, Ceramic	020-124-9-008
C5	Not Used	
C6	12 pF ±5%, 50 V, Ceramic	020-167-9-002
C7	0.01 µF, 50 V, Ceramic	020-341-9-003
C8	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C9-11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12, 13	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C14	0.01 µF, 50 V, Ceramic	020-341-9-003
C15	33 µF ±20%, 35 V, Electrolytic	022-267-9-006
C16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C18	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C19, 20	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C21	Not Used	
C22	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C23	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C24, 25	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C26, 27	0.01 µF, 50 V, Ceramic	020-341-9-003
TC1, 2	20 pF, Trimmer Capacitor	028-065-9-004
	INDUCTORS	
L1, 2	Choke Coil	041-148-9-003
L3, 4	0.22 µH, Ferrite	041-133-9-009
L5-8	47 µH, Ferrite	041-143-9-002
	DIODES	
D1	MTZ24JC, 24 V Zener	152-136-9-005
D2, 3	1S2686	151-097-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	TRANSISTORS	
Q1, 2	2SC2671(H), NPN Silicon	176-157-9-006
Q3, 4	2SA1206, PNP Silicon	177-071-9-003
Q5, 6	2SC2671(H), NPN Silicon	176-157-9-006
Q7-10	2SC2644, NPN Silicon	176-114-9-008
Q11, 12	2SC1164, NPN Silicon	176-114-9-007
Q13	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q14	2SC3311(Q,R), NPN Silicon	176-157-9-007
Q15, 16	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q17	2SC3311(Q,R), NPN Silicon	176-157-9-007
Q18	2SA1309(Q,R), PNP Silicon	177-071-9-001
	MISCELLANEOUS	
TH1	SDT1000, Thermistor	005-003-9-002
	Bead Core	040-004-9-002

CPU UNIT
(X81-1320-00)

RESISTORS
Resistors are ±5%, 1/6 W. See schematic diagram for value.

CAPACITORS

C1	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C2	82 pF ±5%, 50 V, Ceramic	020-250-9-002
C3	2.2 µF ±20%, 50 V, Electrolytic	022-281-9-004
C4, 5	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001

DIODES

D1-4	GMA-01	151-111-9-001

TRANSISTORS

Q1	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q2	2SC3311(R), NPN Silicon	176-157-9-002

INTEGRATED CIRCUITS

IC1	MTM5010, 4-Bit Microcomputer	307-355-9-013
IC2, 3	AN90B20, Transistor Array	307-355-9-012

A TRIGGER SWITCH UNIT
(X77-1280-00)

RESISTORS
Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R9	47 kΩ ±1%, 1/6 W, Metal Film	013-085-9-017

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R10, 11	15 kΩ ±1%, 1/6 W, Metal Film	015-164-1-502
R12	47 kΩ ±1%, 1/6 W, Metal Film	013-085-9-017
R20, 21	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R27, 28	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R32, 33	270 Ω ±1%, 1/6 W, Metal Film	013-085-9-012
R30	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R31	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
VR1	100 kΩ Potentiometer, TRIG LEVEL Control	008-482-9-002
VR2	10 kΩ Trimpot	008-434-9-007
VR3	1 kΩ Trimpot	008-434-9-005
VR4	2 kΩ Trimpot	008-470-9-003
	CAPACITORS	
C1	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C2, 3	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C4, 5	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7, 8	7 pF ±0.5 pF, 50 V, Ceramic	020-149-9-001
C9	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C10, 11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12	Not Used	
C13	0.01 µF, 50 V, Ceramic	020-341-9-003
C14	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C15	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C16	Not Used	
C17	1 µF ±20%, 50 V, Electrolytic	022-167-9-001
C18	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C19	1 µF ±20%, 50 V, Electrolytic	022-226-9-017
C20	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
C21-24	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C25	Not Used	
C26-38	0.01 µF, 50 V, Ceramic	020-341-9-003
C39-41	Not Used	
C42	0.01 µF, 50 V, Ceramic	020-341-9-003
C43	Not Used	
C44, 45	0.01 µF, 50 V, Ceramic	020-341-9-003
C46	Not Used	
C47, 48	0.01 µF, 50 V, Ceramic	020-341-9-003
C49	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
TC1	20 pF Trimmer Capacitor	028-065-9-001
	INDUCTORS	
L1, 2	100 µH, Ferrite	041-124-9-001
	DIODES	
D1	SV03Y	153-022-9-001
D2, 3	GMA-01	151-111-9-001
D4	MTZ16JA, 15 V Zener	152-134-9-002
D5-8	GMA-01	151-111-9-001
D9	SV04Y	153-026-9-001
	TRANSISTORS	
Q1	2SJ43(Q), P-Channel FET	182-064-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q2	2SK127(Q), FET	182-064-9-002
Q3	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q4, 5	2SC3354(T,S), NPN Silicon	176-157-9-004
Q6, 7	2SA1161, PNP Silicon	177-048-9-003
Q8	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q9	2SC3066, NPN Silicon	176-157-9-008
Q10, 11	2SC2671(H), NPN Silicon	176-157-9-006
Q12-15	2SC3354(T,S), NPN Silicon	176-157-9-004
Q16	2SC2671(H), NPN Silicon	176-157-9-006
Q17	2SC3311(R), NPN Silicon	176-157-9-002
Q18	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q19	2SK30A(O), N-Channel FET	182-040-9-001
Q20	2SC3311(R), NPN Silicon	176-157-9-002
Q21	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q22	2SC3311(R), NPN Silicon	176-157-9-002
Q23	2SA3109(Q,R), PNP Silicon	177-071-9-001
Q24	2SK30A(O), N-Channel FET	182-040-9-001
Q25	2SA3109(Q,R), PNP Silicon	177-071-9-001
	MISCELLANEOUS	
S1	6 Positon Lever Switch, Trigger SOURCE Control	080-024-9-001
S2	5 Position Lever Switch, Trigger COUPLING Control	080-003-9-002
	Bead Core	040-004-9-002

B TRIGGER SWITCH UNIT
(X77-1290-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R16, 17	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R23, 24	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R26, 27	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R28, 29	270 Ω ±1%, 1/6 W, Metal Film	013-085-9-012
VR1	100 kΩ Potentiometer, TRIG LEVEL Control	008-482-9-003
VR2	10 kΩ Trimpot	008-434-9-007
VR3	2 kΩ Trimpot	008-470-9-003

CAPACITORS

C1	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C2	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C3, 4	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C5, 6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7, 8	7 pF ±0.5 pF, 50 V, Ceramic	020-337-9-004
C9	0.01 µF, 50 V, Ceramic	020-341-9-003
C10	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C11-16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C18-23	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C24-35	0.01 µF, 50 V, Ceramic	020-341-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C36, 37	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
TC1	20 pF Trimmer Capacitor	028-065-9-004
	INDUCTORS	
L1, 2	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	MTZ8.2JB, 8.1 V Zener	152-136-9-007
D2	SV03Y	153-022-9-001
D3	SV04Y	153-026-9-001
	TRANSISTORS	
Q1	2SC3354(T,S), NPN Silicon	176-157-9-004
Q2	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q3, 4	2SC3354(T,S), NPN Silicon	176-157-9-004
Q5, 6	2SA1161, PNP Silicon	177-048-9-003
Q7	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q8	2SC3066, NPN Silicon	176-157-9-008
Q9, 10	2SC2671(H), NPN Silcon	176-157-9-006
Q11-14	2SC3354(T,S), NPN Silicon	176-157-9-004
Q15	2SC2671(H), NPN Silicon	176-157-9-006
	MISCELLANEOUS	
S1, 2	4 Position Lever Switch, B Trigger COUPLING and SOURCE Controls	080-004-9-002
	Bead Core	040-004-9-002

SWEEP ROTARY UNIT
(X74-1310-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R1	360 kΩ ±1%, 1/8 W, Metal Film	013-087-9-005
R2	120 kΩ ±1%, 1/8 W, Metal Film	013-087-9-002
R3, 4	30 kΩ ±1%, 1/8 W, Metal Film	013-073-9-005
R5	36 kΩ ±1%, 1/8 W, Metal Film	013-087-9-004
R6	12 kΩ ±1%, 1/8 W, Metal Film	013-087-9-001
R7, 8	3 kΩ ±1%, 1/8 W, Metal Film	013-052-9-023
R9	3.6 kΩ ±1%, 1/8 W, Metal Film	013-087-9-003
R20	360 kΩ ±1%, 1/8 W, Metal Film	013-087-9-005
R21	120 kΩ ±1%, 1/8 W, Metal Film	013-087-9-002
R22, 23	30 kΩ ±1%, 1/8 W, Metal Film	013-073-9-005
R24	36 kΩ ±1%, 1/8 W, Metal Film	013-087-9-004
R25	12 kΩ ±1%, 1/8 W, Metal Film	013-087-9-001
R26, 27	3 kΩ ±1%, 1/8 W, Metal Film	013-052-9-023
R28	3.6 kΩ ±1%, 1/8 W, Metal Film	013-087-9-003

CAPACITORS

C1-4	0.01 µF ±10%, 50 V, Ceramic	020-296-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	DIODES	
D1	GMA-01	151-111-9-001
D2-8	1SS135	151-118-9-001
D9	GMA-01	151-111-9-001
D10-16	1SS135	151-118-9-001
	SWITCHES	
S1-4	Rotary Switch, SWEEP TIME/DIV control	083-289-9-001

TRIGGER SWEEP UNIT
(X74-1350-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R34	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R35, 36	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R38	24 kΩ ±1%, 1/6 W, Metal Film	013-085-9-030
R39	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R40	12 kΩ ±1%, 1/6 W, Metal Film	013-085-9-028
R41	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R43	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R45	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R91	510 Ω ±1%, 1/6 W, Metal Film	013-085-9-033
R92, 93	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R150	7.5 kΩ ±1%, 1/6 W, Metal Film	015-164-7-501
R151	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R152	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R154	24 kΩ ±1%, 1/6 W, Metal Film	013-085-9-030
R155	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R156	12 kΩ ±1%, 1/6 W, Metal Film	013-085-9-028
R157	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R159	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R161	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R199	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R201	6.8 kΩ ±1%, 1/6 W, Metal Film	013-085-9-035
R203	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R205	6.8 kΩ ±1%, 1/6 W, Metal Film	013-085-9-035
R206	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R207	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R208	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R209	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R213	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R214	2 kΩ ±1%, 1/6 W, Metal Film	015-164-2-001
R215	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R219	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R220	6.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-034
R224, 225	470 Ω ±1%, 1/6 W, Metal Film	013-085-9-016
R227, 228	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R229, 230	1.6 kΩ ±1%, 1/6 W, Metal Film	013-085-9-029

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R233, 234	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R235	150 Ω ±1%, 1/6 W, Metal Film	015-164-1-500
R236, 237	820 Ω ±1%, 1/6 W, Metal Film	013-085-9-036
R302	91 kΩ ±1%, 1/6 W, Metal Film	013-085-9-037
R303	100 kΩ ±1%, 1/6 W, Metal Film	015-164-1-003
R307	300 Ω ±1%, 1/6 W, Metal Film	013-085-9-031
R308	100 Ω ±1%, 1/6 W, Metal Film	015-164-1-000
VR1	10 kΩ Trimpot	008-467-9-008
VR2	5 kΩ Trimpot	008-434-9-013
VR3	10 kΩ Trimpot	008-467-9-008
VR4	5 kΩ Trimpot	008-434-9-013
VR5	200 Ω Trimpot	008-434-9-001
VR6	5 kΩ Trimpot	008-434-9-013
VR7, 8	1 kΩ Trimpot	008-434-9-012
VR9, 10	5 kΩ Trimpot	008-434-9-013
VR11, 12	2 kΩ Trimpot	008-434-9-011
VR13	100 Ω Trimpot	008-434-9-002
VR14	500 Ω Trimpot	008-434-9-003
VR15	10 kΩ Trimpot	008-467-9-008
VR16	100 kΩ Trimpot	008-467-9-006
VR17	200 Ω Trimpot	008-434-9-001
	CAPACITORS	
C1	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C2, 3	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C4	0.01 µF, 50 V, Ceramic	020-341-9-003
C5	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7	22 µF ±20%, 35 V, Electrolytic	022-281-9-002
C8	0.01 µF, 50 V, Ceramic	020-341-9-003
C9	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C10, 11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
C13	10 µF ±10%, Plastic	033-077-9-005
C14, 15	0.01 µF, 50 V, Ceramic	020-341-9-003
C16	0.033 µF ±10%, 50 V, Mylar	025-056-9-004
C17	0.1 µF ±5%, Ceramic	033-077-9-006
C18, 19	0.01 µF, 50 V, Ceramic	020-341-9-003
C20	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C21	1000 pF ±10%, Ceramic	033-077-9-004
C22	0.01 µF, 50 V, Ceramic	020-341-9-003
C23	120 pF ±5%, 100 V, Mica	023-085-9-001
C24	0.01 µF, 50 V, Ceramic	020-341-9-003
C25	120 pF ±5%, 50 V, Ceramic	020-103-9-001
C26	Not Used	
C27	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C28, 29	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C30	0.01 µF, 50 V, Ceramic	020-341-9-003
C31	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C32, 33	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C34	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C35	0.01 µF, 50 V, Ceramic	020-341-9-003
C36	22 µF ±20%, 35 V, Electrolytic	022-281-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C37	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C38, 39	0.01 µF, 50 V, Ceramic	020-341-9-003
C40	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
C41	10 µF ±10%, Plastic	033-077-9-005
C42, 43	0.01 µF, 50 V, Ceramic	020-341-9-003
C44	0.033 µF ±10%, 50 V, Mylar	025-056-9-004
C45	0.1 µF ±5%, Ceramic	033-077-9-006
C46, 47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C49	1000 pF ±10%, Ceramic	033-077-9-004
C50, 51	0.01 µF, 50 V, Ceramic	020-341-9-003
C52	120 pF ±5%, 50 V, Ceramic	020-103-9-001
C53	120 pF ±5%, 100 V, Mica	023-085-9-001
C54	0.01 µF, 50 V, Ceramic	020-341-9-003
C55	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C56	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C57, 58	0.01 µF, 50 V, Ceramic	020-341-9-003
C59	680 pF ±10%, 50 V, Ceramic	020-200-9-003
C60	47 pF ±5%, 100 V, Mica	023-056-9-002
C61	39 pF ±5%, 100 V, Mica	023-059-9-001
C62	22 pF ±5%, 50 V, Ceramic	020-124-9-007
C63, 64	1000 pF ±5%, 50 V, Mylar	025-219-9-001
C65	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C66, 67	4700 pF ±5%, 50 V, Mylar	025-153-9-003
C68	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C69	470 pF ±5%, 50 V, Ceramic	020-233-9-003
C70-72	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C73-75	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C76	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C77	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C78	0.01 µF, 50 V, Ceramic	020-341-9-003
C79	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C80	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C81-84	0.01 µF, 50 V, Ceramic	020-341-9-003
C85	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C86-88	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C89	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C90, 91	0.01 µF, 50 V, Ceramic	020-341-9-003
C92-103	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C104-106	22 µF ±20%, 25 V, Electrolytic	022-264-9-001
C107	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C108	0.01 µF, 50 V, Ceramic	020-341-9-003
C109	33 µF ±20%, 25 V, Electrolytic	022-276-9-003
C110	4.7 µF ±20%, 63 V, Electrolytic	022-226-9-010
C111	10 µF ±20%, 63 V, Electrolytic	022-244-9-002
C112-114	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C115	Not Used	
C116	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C117	22 pF ±5%, 50 V, Ceramic	020-124-9-007
C118	330 pF ±5%, 50 V, Ceramic	020-158-9-004
TC1, 2	40 pF Trimmer Capacitor	028-069-9-001
TC3, 4	6 pF Trimmer Capacitor	028-065-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	INDUCTORS	
L1, 2	10 µH, Ferrite	041-133-9-003
L3	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	Not Used	
D2-4	GMA-01	151-111-9-001
D5	MTZ3.0JB, 3.0 V Zener	152-136-9-006
D6	GMA-01	151-111-9-001
D7	DS442X, Silicon Switching	151-097-9-001
D8	GMA-01	151-111-9-001
D9	DS442X, Silicon Switching	151-097-9-001
D10, 11	GMA-01	151-111-9-001
D12	DS442X, Silicon Switching	151-097-9-001
D13	MTZ16JA, 15 V Zener	152-134-9-002
D14-21	GMA-01	151-111-9-001
D22	Not Used	
D23-30	GMA-01	151-111-9-001
D31	Not Used	
D32-36	GMA-01	151-111-9-001
D37	DS442X, Silicon Switching	151-097-9-001
D38	GMA-01	151-111-9-001
D39	DS442X, Silicon Switching	151-097-9-001
D40, 41	GMA-01	151-111-9-001
D42	DS442X, Silicon Switching	151-097-9-001
D43	MTZ16JA, 15 V Zener	152-134-9-002
D44	MTZ3.0JB, 3.0 V Zener	152-136-9-006
D45-52	GMA-01	151-111-9-001
D53, 54	MTZ12JC, 12 V Zener	152-136-9-001
D55	SV06Y	153-019-9-001
D56-59	GMA-01	151-111-9-001
D60	SV06Y	153-019-9-001
D61-69	GMA-01	151-111-9-001
D70	Not Used	
D71, 72	GMA-01	151-111-9-001
D73	1N60, Germanium	150-001-9-005
	TRANSISTORS	
Q1-3	2SC3311(R), NPN Silicon	176-157-9-002
Q4	2SA1323(B), PNP Silicon	177-071-9-002
Q5	2SC3354(T,S), NPN Silicon	176-157-9-004
Q6	2SC1973(T), NPN Silicon	176-099-9-002
Q7	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q8	2SD438(F), NPN Silicon	172-058-9-002
Q9-17	2SC3311(R), NPN Silicon	176-157-9-002
Q18	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q19	2SC3315(C,D), NPN Silicon	176-157-9-003
Q20	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q21	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q22	2SC3315(C,D), NPN Silicon	176-157-9-003
Q23-26	2SC3311(R), NPN Silicon	176-157-9-002
Q27-30	2SA1323(B), PNP Silicon	177-071-9-002
Q31-33	2SC3311(R), NPN Silicon	176-157-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q34	2SA1323(B), PNP Silicon	177-071-9-002
Q35	2SC3354(T,S), NPN Silicon	176-157-9-004
Q36	2SC1973(T), NPN Silicon	176-099-9-002
Q37	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q38	2SD438(F), NPN Silicon	172-058-9-002
Q39-47	2SC3311(R), NPN Silicon	176-157-9-002
Q48	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q49	2SC3315(C,D), NPN Silicon	176-157-9-003
Q50	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q51	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q52	2SC3315(C,D), NPN Silicon	176-157-9-003
Q53, 54	2SC3311(R), NPN Silicon	176-157-9-002
Q55-61	2SC3315(C,D), NPN Silicon	176-157-9-003
Q62	2SA1239(F), Dual PNP Silicon	177-068-9-001
Q63	Not Used	
Q64-67	2SC3315(C,D), NPN Silicon	176-157-9-003
Q68, 69	2SC3311(R), NPN Silicon	176-157-9-002
Q70, 71	2SC3315(C,D), NPN Silicon	176-157-9-003
Q72	2SA1323(B), PNP Silicon	177-071-9-002
Q73	2SC3354(T,S), NPN Silicon	176-157-9-004
Q74	2SA1323(B), PNP Silicon	177-071-9-002
Q75	2SC3354(T,S), NPN Silicon	176-157-9-004
Q76	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q77	2SA1323(B), PNP Silicon	177-071-9-002
Q78	2SC3311(R), NPN Silicon	176-157-9-002
Q79-82	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q83, 84	2SA1323(B), PNP Silicon	177-071-9-002
	INTEGRATED CIRCUITS	
IC1	MC10H103L, Quad 2-Input OR GATE	307-355-9-007
IC2	MC10H131L, Dual D-Flip Flop	307-355-9-008
IC3	LF412CN, Dual JFET Input Op-Amp	307-355-9-006
IC4	MC10H103L, Quad 2-Input OR GATE	307-355-9-007
IC5	MC10H131L, Dual D-Flip Flop	307-355-9-008
IC6	LF412CN, Dual JFET Input Op-Amp	307-355-9-006
IC7	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC8	MC10103L, Quad 2-Input OR GATE	307-309-9-003
IC9-11	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC12	MC10102L, Quad 2-Input NOR GATE	307-301-9-001
IC13	MC10131L, Dual D-Flip Flop	307-309-9-005
IC14	SN7406, Hex Open Collector Inverters	307-355-9-011
IC15	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC16	MC78L05CP, Voltage Regulator, 5 V, 100 mA	307-355-9-009
IC17	MC78L15ACP, Voltage Regulator, 5 V, 100 mA	307-355-9-010

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.

HORIZONTAL OUTPUT AMP UNIT
(X74-1360-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R6, 7	47 kΩ ±5%, 1/2 W, Carbon Film	002-102-5-473
R12, 13	22 kΩ ±5%, 1 W, Metal Film	011-001-5-223
R16	12 kΩ ±5%, 1/2 W, Carbon Film	002-102-5-123

CAPACITORS

C1	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C2-5	0.01 µF, 50 V, Ceramic	020-341-9-003
C6 -9	1 pF ± 0.25 pF, 500 V, Ceramic	020-326-9-002
C10	0.01 µF, 50 V, Ceramic	020-341-9-003
C11-13	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C14	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C15	0.01 µF, 50 V, Ceramic	020-341-9-003
C16	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C17	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C18	0.01 µF, 50 V, Ceramic	020-341-9-003
C19, 20	100 µF ± 20%, 16 V, Electrolytic	022-222-9-014
C21	10 µF ± 20%, 100 V, Electrolytic	021-069-9-002
C22	2.2 µF, 160 V, Electrolytic	021-077-9-001
C23	0.01 µF, 50 V, Ceramic	020-341-9-003
C24	7 pF ± 0.5 pF, 50 V, Ceramic	020-149-9-001

INDUCTORS

L1-4	100 µH, Ferrite	041-133-9-004

DIODES

D1	DS442X, Silicon Switching	151-097-9-001
D2	MTZ5.1JB, 5 V Zener	152-134-9-003

TRANSISTORS

Q1-4	2SA1323(B), PNP Silicon	177-071-9-002
Q5, 6	2SC805A-2(2,3), NPN Silicon	176-114-9-002
Q7, 8	2SA923-2(2,3), PNP Silicon	177-041-9-001
Q9-11	2SC331(R), NPN Silicon	176-157-9-002

POWER BLANKING UNIT
(X68-1400-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.

R6	130 kΩ ±1%, 1/6 W, Metal Film	015-164-1-303
R7	5.6 kΩ ±1%, 1/6 W, Metal Film	013-085-9-006
R10, 11	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R12	100 Ω ±1%, 1/6 W, Metal Film	015-164-1-000

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R15	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R16	3.9 kΩ ±1%, 1/6 W, Metal Film	013-085-9-004
R19	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R20	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R22	13 kΩ ±1%, 1/6 W, Metal Film	015-164-1-302
R23	8.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-008
R32	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R33	9.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-009
R68	62 kΩ ±1%, 1/6 W, Metal Film	013-085-9-007
R74	15 MΩ ±5%, 1/2 W, Fixed	004-193-9-002
R75	5.1 MΩ ±5%, 1/2 W, Fixed	004-211-9-001
R76	4.7 MΩ ±5%, 1 W, Fixed	004-211-9-002
R77	4.3 MΩ ±5%, 1 W, Fixed	004-211-9-003
R78	3 MΩ ±5%, 1/2 W, Fixed	004-193-9-001
R79	47 MΩ ±5%, 1/2 W, Fixed	004-181-9-002
VR1	4.7 kΩ, Trimpot	008-298-9-009
VR2	10 kΩ, Trimpot	008-298-9-010
VR3	47 kΩ, Trimpot	008-298-9-012
VR4	3 MΩ, Potentiometer, FOCUS control	008-390-9-001
VR5	10 kΩ, Potentiometer, SCALE ILLUM control	008-406-9-006
VR6	1 kΩ, Potentiometer, A INTENSITY, B INTENSITY control	008-406-9-005
	CAPACITORS	
C1, 2	0.01 µF, 50 V, Ceramic	020-341-9-003
C3	10 µF ±20%, 35 V, Electrolytic	022-226-9-003
C4	33 µF ±20%, 63 V, Electrolytic	022-226-9-005
C5, 6	3.3 µF, 160 V, Electrolytic	021-074-9-001
C7	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C8	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C9, 10	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C11	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C12	10 µF ±20%, 35 V, Electrolytic	022-226-9-003
C13	0.01 µF, 50 V, Ceramic	020-341-9-003
C14	47 µF ±20%, 35 V, Electrolytic	022-226-9-004
C15, 16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17, 18	100 pF ±5%, 50 V, Ceramic	020-341-9-001
C19, 20	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C21, 22	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C23	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C24	0.5 pF ±0.25 pF, 500 V, Ceramic	020-341-9-002
C25	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C26	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C27	3 pF ±0.25 pF, 500 V, Ceramic	020-326-9-008
C28	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C29	0.01 µF, 50 V, Ceramic	020-341-9-003
C30	3.3 µF, 160 V, Electrolytic	021-074-9-001
C31	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C32	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C33	0.01 µF, 50 V, Ceramic	020-341-9-003
C34	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C35	0.01 µF, 50 V, Ceramic	020-341-9-003
C36-39	0.01 µF ±0.25 pF, 3 kV, Ceramic	033-077-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C40	1000 pF, 3.1 kV, Ceramic	020-226-9-003
C41	0.15 µF ±10%, 50 V, Mylar	025-192-9-001
C42, 43	0.01 µF, 50 V, Ceramic	020-341-9-003
C44	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C45	0.01 µF, 50 V, Ceramic	020-341-9-003
C46	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C49	4700 pF ±10%, 50 V, Mylar	025-107-9-007
C50	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C51	0.01 µF, 50 V, Ceramic	020-341-9-003
C52, 53	0.01 µF ±0.25 pF, 3 kV, Ceramic	033-077-9-001
C54	1000 pF, 2 kV, Ceramic	020-226-9-002
C55	2200 pF ±10%, 500 V, Ceramic	020-302-9-004
C56-58	Not Used	
C59, 60	0.01 µF, 50 V, Ceramic	020-341-9-003
C61	47 µF ±20%, 16 V, Electrolytic	022-226-9-012
TC1, 2	20 pF Trimmer Capacitor	028-050-9-002
TC3	2 pF Trimmer Capacitor	028-079-9-001
	INDUCTORS	
L1-5	100 µH, Ferrite	041-133-9-004
L6	100 µH, Ferrite	041-124-9-001
L7, 8	100 µH, Ferrite	041-133-9-004
	DIODES	
D1	DS442X, Silicon Switching	151-097-9-001
D2, 3	MTZ12JC, 12 V Zener	152-136-9-001
D4	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D5	DS442X, Silicon Switching	151-097-9-001
D6, 7	Not Used	
D8	DS442X, Silicon Switching	151-097-9-001
D9	MTZ5.1JB, 5 V Zener	152-134-9-003
D10, 11	1SS83, Silicon Switching	151-084-9-001
D12-15	W06C, Silicon Rectifier	151-052-9-002
D16, 17	DS442X, Silicon Switching	151-097-9-001
D18	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D19	MTZ6.2JB, 6.1 V Zener	152-136-9-003
D20	DS442X, Silicon Switching	151-097-9-001
	TRANSITORS	
Q1	2SC2591(Q,R), NPN Silicon	176-157-9-001
Q2	2SC1505(L), NPN Silicon	172-058-9-001
Q3	2SB633(E), PNP Silicon	173-010-9-001
Q4	2SD613(E), NPN Silicon	176-104-9-002
Q5	2SB633(E), PNP Silicon	173-010-9-001
Q6	2SC1505(L), NPN Silicon	172-058-9-001
Q7	2SC3311(R), NPN Silicon	176-157-9-002
Q8	2SC1505(L), NPN Silicon	172-058-9-001
Q9	2SC3311(R), NPN Silicon	176-157-9-002
Q10	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q11, 12	2SC3354(T,S), NPN Silicon	176-157-9-004
Q13	2SA1323(B), PNP Silicon	177-071-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q14	2SC3311(R), NPN Silicon	176-157-9-002
Q15-17	2SC3315(C,D), NPN Silicon	176-157-9-003
Q18	2SC805A-2(2,3), NPN Silicon	176-114-9-002
Q19	2SA923-2(2,3), PNP Silicon	177-041-9-001
Q20	2SC2910(S,T), NPN Silicon	176-126-9-001
Q21	2SA1208(S,T), PNP Silicon	177-053-9-001
Q22, 23	2SC2910(S,T), NPN Silicon	176-126-9-001
Q24, 25	2SC3311(R), NPN Silicon	176-157-9-002
Q26	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q27	2SK192A-BL, N-Channel FET	182-076-9-001
Q28	2SD613(E), NPN Silicon	176-104-9-002
	INTEGRATED CIRCUITS	
IC1, 2	NJM4558D, Dual Op-Amp	307-333-9-001
IC3	LM340LAZ5.0, Regulator	307-355-9-001
	MISCELLANEOUS	
NL1-4	Neon Lamp	401-024-9-001
PL1-4	Lamp	400-082-9-001
	Neon Tube Holder	253-117-9-001

SWITCHING POWER SUPPLY
(W02-0413-05)

RESISTORS

Unlisted resistors are ±5%, 1/4 W. See schematic diagram for value.

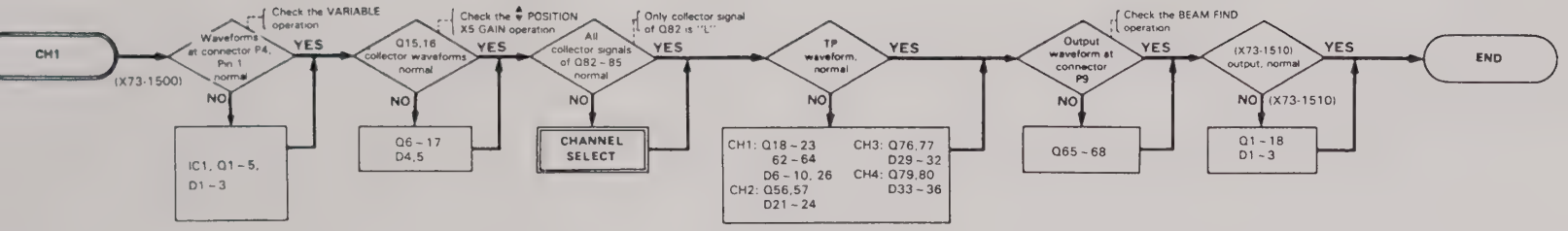
R1	10 Ω, 3 W, Wire Wound	004-215-9-001
R2	2 Ω, 3 W, Wire Wound	004-215-9-002
R4	220 kΩ, 1 W, Metal Oxide	004-215-9-003
R7	33 Ω, 1 W, Metal Oxide	004-215-9-004
R12	2.2 kΩ ±1%, 1/4 W, Metal Film	013-013-9-009
VR1	10 kΩ Trimmer Pot	008-502-9-001

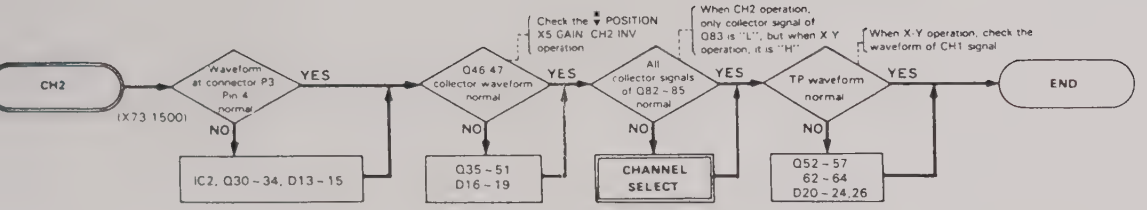
CAPACITORS

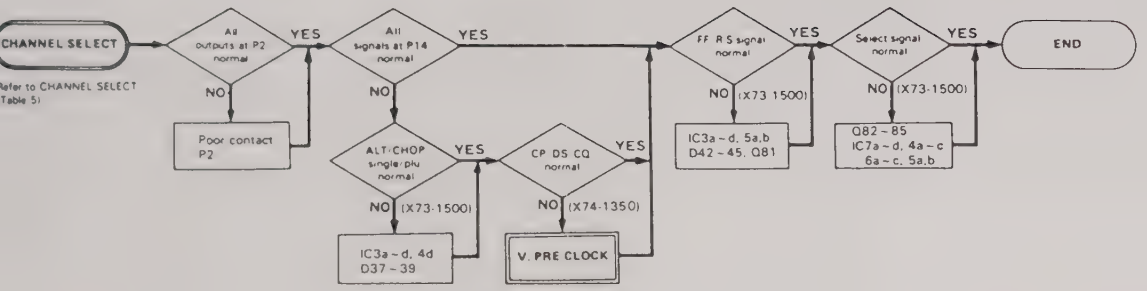
C1	0.22 µF, 400 V, Polyester	033-082-9-003
C2-5	2200 pF, 250 V, Ceramic	033-082-9-001
C6	100 µF, 400 V, Electrolytic	033-083-9-001
C7	4.7 µF, 50 V, Electrolytic	033-083-9-002
C8	10 µF, 50 V, Electrolytic	033-083-9-003
C9	47 µF, 25 V, Electrolytic	033-083-9-004
C10	0.01 µF, 50 V, Ceramic	020-296-9-001
C11	0.001 µF, 1 kV, Ceramic	033-082-9-002
C12	470 µF, 16 V, Electrolytic	033-083-9-005
C13	1000 µF, 10 V, Electrolytic	033-083-9-006
C14	470 µF, 16 V, Electrolytic	033-083-9-005
C15	220 µF, 35 V, Electrolytic	033-083-9-007
C16	100 µF, 63 V, Electrolytic	033-083-9-008
C17	22 µF, 160 V, Electrolytic	033-083-9-009
C18	220 µF, 16 V, Electrolytic	033-083-9-010

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C19	220 µF, 35 V, Electrolytic	033-083-9-007
C20	22 µF, 50 V, Electrolytic	033-083-9-011
C21	10 µF, 100 V, Electrolytic	033-083-9-012
C22	22 µF, 160 V, Electrolytic	033-083-9-009
C23	0.01 µF, 630 V, Ceramic	033-082-9-004
C24, 25	0.001 µF, 1 kV, Ceramic	033-082-9-002
C26	22 µF, 16 V, Electrolytic	033-083-9-013
	INDUCTORS	
L1	Line Filter	064-029-9-001
L2	Pulse Transformer	064-029-9-002
L3	20 µH Coil	041-153-9-001
L4	2.3 µH Coil	041-153-9-002
L5	20 µH Coil	041-153-9-001
L6-8	*4.7 µH Ferri-Inductor*	*041-153-9-003*
	DIODES	
D1	*DBA20G*	*157-033-9-001*
D2	*DFA01*	*151-122-9-001*
D3	*DTA-10ER, Triac*	*181-014-9-001*
D4	DS442X	151-097-9-001
D5, 6	GFD10E	151-122-9-002
D7	GFD10G	151-122-9-003
D8	HZ3.6CP, Zener Diode	152-139-9-001
D9	GZA6.2Z, Zener Diode	152-139-9-002
	TRANSISTORS	
Q1	2SC536KNP(F), NPN Transistor	176-114-9-001
	INTEGRATED CIRCUITS	
IC1	STK7308	307-368-9-001
	Insulator for IC1	342-122-9-001
IC2	STK732	307-369-9-001
	Insulator for IC2	342-122-9-002

TROUBLESHOOTING




CH2
(X73 1500)
Waveform at connector P3 Pin 4 normal
YES
NO
IC2, Q30 ~ 34, D13 ~ 15
Q46 47 collector waveform normal
Check the ▲▼ POSITION X5 GAIN CH2 INV operation
YES
NO
Q35 ~ 51 D16 ~ 19
All collector signals of Q82 ~ 85 normal
When CH2 operation, only collector signal of Q83 is "L", but when X Y operation, it is "H"
YES
NO
CHANNEL SELECT
TP waveform normal
When X-Y operation, check the waveform of CH1 signal
YES
NO
Q52 ~ 57 62 ~ 64 D20 ~ 24,26
END



CHANNEL SELECT

			MODE INPUT LOG OUTPUT signal (P2)						FLIP-FLOP PRESET CLEAR signal			CHANNEL SELECT signal				FLIP-FLOP OUTPUT signal				VERTICAL CLOCK (P14)				
			CH1	CH2	DUAL	ADD	ALT	X-Y	R5a	S5a	R5b	CH1	CH2	CH3	CH4	Q5a	Q5a	Q5b	Q5b	ALT CHOP	Single-plu	CP *2	DS	CQ *4
SWEEP operation		CH1	L	H	H	H	H	H	H	L	H	L	H	L	H	L	H	L	H	L	L	QA	H	H
		CH2	H	L	H	H	H	H	L	H	H	H	L	H	H	H	L	L	H	L	L	QA	H	H
	DUAL	ALT	H	H	L	H	L	H	L	L	H	①		H	H	① *1		L	H	L	H	QA	L*3	H
		CHOP					H					③				③				H		③		
		ADD	H	H	H	L	H	H	L	L	H	L	L	H	H	⑤		L	H	L	L	QA	H	H
	QUAD	ALT	H	H	H	H	L	H	L	L	L	②				② *1		②		L	H	QA	L*3	H
		CHOP					H					④				④		④		H		④		
X Y operation			Same as above					L	H	H	H	L	H	H	H			L	H	L	L	L	H	H

Note Number of ○ is No. of time chart (See Fig 11)

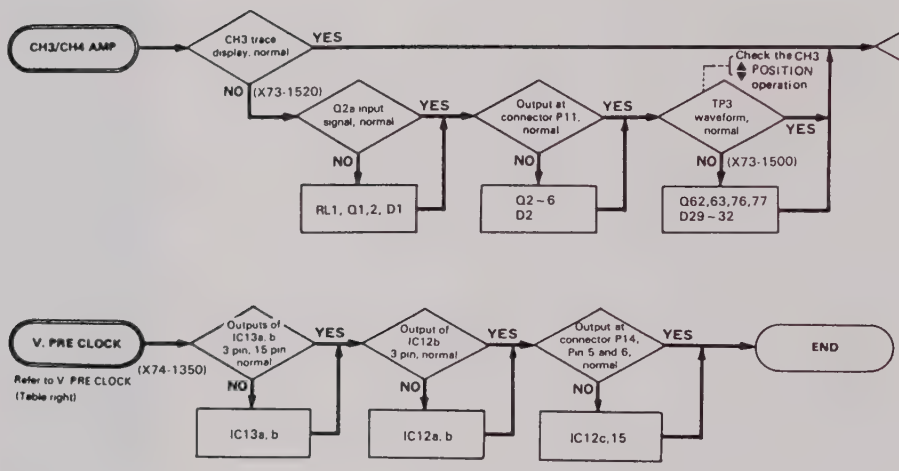
*1 Vertical MODE;
DUAL (ALT)
QUAD (ALT)
HORIZ DISPLAY, DUAL
Time chart No. ⑤

*2 HORIZ DISPLAY;
ALT, DUAL
Time chart No. ⑤.

*3 Vertical MODE.
DUAL
QUAD
HORIZ DISPLAY.
DUAL
Time chart NO ① ~ ④

*4 HORIZ DISPLAY.
DUAL
Signal level "L"

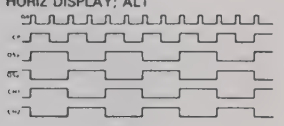
Table-5



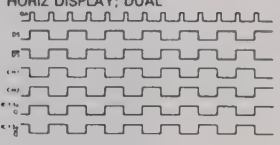
① Vertical MODE; DUAL (ALT)

HORIZ DISPLAY; A, A-INT-B, B DLY'D

HORIZ DISPLAY; ALT

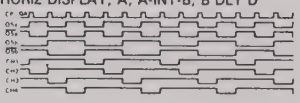


HORIZ DISPLAY; DUAL

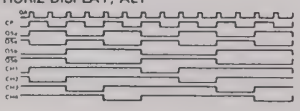


② Vertical MODE; QUAD (ALT)

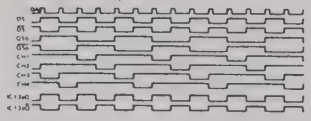
HORIZ DISPLAY; A, A-INT-B, B DLY'D



HORIZ DISPLAY; ALT



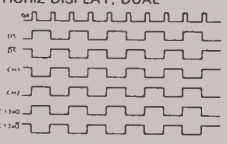
HORIZ DISPLAY; DUAL



③ Vertical MODE; DUAL (CHOP)

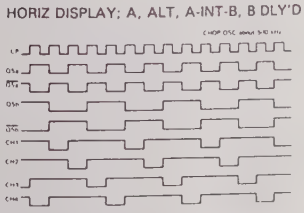
HORIZ DISPLAY; A, ALT, A-INT-B, B DLY'D

HORIZ DISPLAY; DUAL

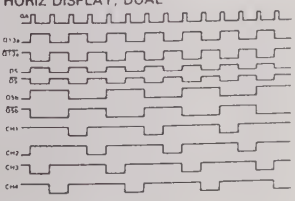


④ Vertical MODE; QUAD (CHOP)

HORIZ DISPLAY; A, ALT, A-INT-B, B DLY'D



HORIZ DISPLAY; DUAL



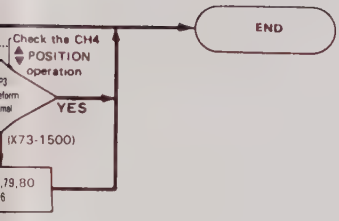
(5) Vertical

HORIZ DIS
B DLY'D,

HORIZ DI

Fig. 11 Time Chart

ING



V. PRE CLOCK

	MODE		INPUT ALT/CHOP	INPUT Single Pin	OUTPUT Q76	OUTPUT IC15a,b	OUTPUT CP*5	OUTPUT DS
SWEEP operation	CH1		L	L	H	QA	QA	H
	CH2		L	L	H		QA	H
	DUAL	ALT	L	H	H		QA	L*5
		CHOP	H		L		③	
	ADD		L	L	H		QA	H
	QUAD	ALT	L	H	H		QA	L*5
		CHOP	H		L		④	
X-Y Operation			L	L	H	L	L	H

Note: Number of ( ) is No. of time chart. (See Fig. 11)

*5 HORIZ DISPLAY, ALT or DUAL
Time chart No. 6
*6 Vertical MODE, DUAL or QUAD
*7 HORIZ DISPLAY DUAL
Time chart No. ① ~ ④

V. PRE CLOCK

HORIZ DISPLAY	IC15b 7 Pin	IC15b 6 Pin*7	IC15a,b OUTPUT	CQ	IC13a Q
A	L	L	QA	H	H
ALT	H	L	L	H	②*6
A-INT-B	L	L	QA	H	H
B DLY'D	L	L	QA	H	L
DUAL	H	L	QA	L	①*6
X-Y	H	L	L	H	H

*7 Vertical MODE
DUAL or QUAD
Time chart No. ④

*8 Vertical MODE
DUAL or QUAD
Time chart No. ① ~ ④.

Table-6

MODE; ADD

LAY; A, A-INT-B, UAL

PLAY; ALT

⑥ Vertical MODE; DUAL (ALT), QUAD (ALT)

HORIZ DISPLAY; A, A-INT-B, B DLY'D

HORIZ DISPLAY; ALT

HORIZ DISPLAY; DUAL

HORIZ DISPLAY; A, A-INT-B, B DLY'D

CP CHOP OSC about 500 kHz

HORIZ DISPLAY; ALT

CP CHOP OSC about 500 kHz

HORIZ DISPLAY; DUAL

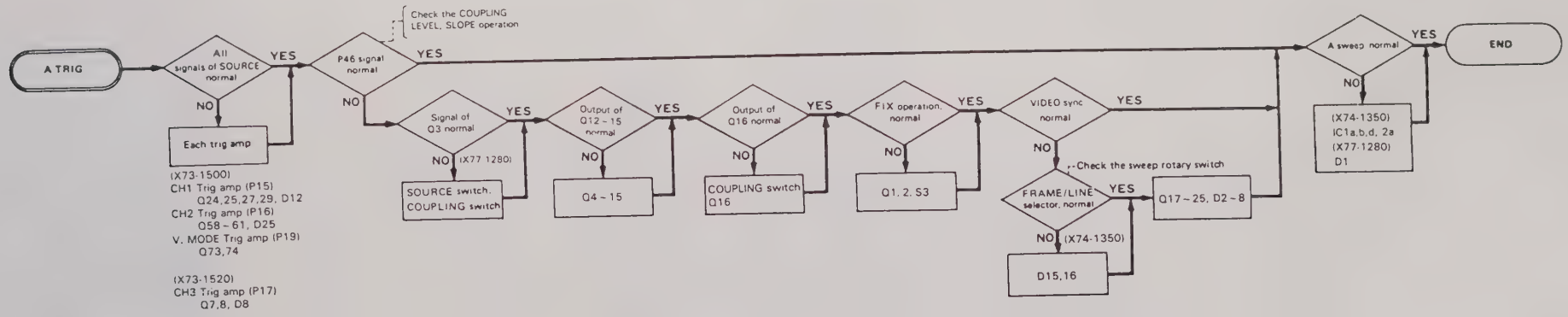
CP CHOP OSC about 500 kHz

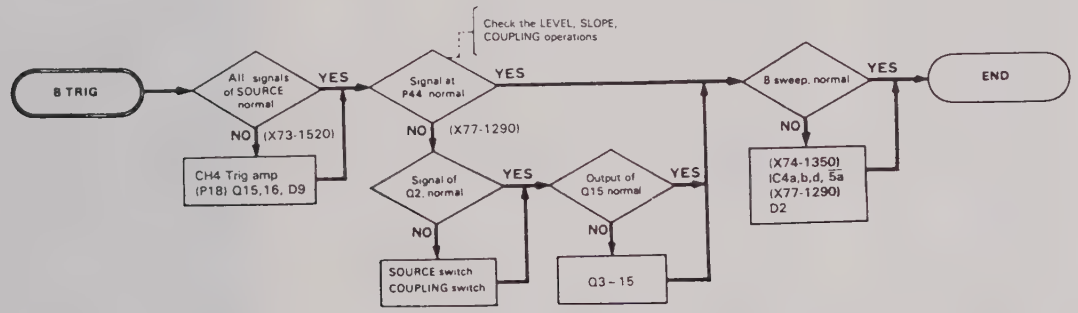
⑦ HORIZ DISPLAY; ALT, DUAL

Vertical MODE; CH1, CH2, ADD

HORIZ DISPLAY ALT

HORIZ DISPLAY DUAL


A TRIG
All signals of SOURCE normal
YES
NO
Each trig amp
(X73-1500)
CH1 Trig amp (P15)
Q24,25,27,29, D12
CH2 Trig amp (P16)
Q58 ~ 61, D25
V. MODE Trig amp (P19)
Q73,74
(X73-1520)
CH3 Trig amp (P17)
Q7,8, D8
Check the COUPLING LEVEL, SLOPE operation
P46 signal normal
Signal of Q3 normal
(X77 1280)
SOURCE switch, COUPLING switch
Output of Q12 ~ 15 normal
Q4 ~ 15
Output of Q16 normal
COUPLING switch Q16
FIX operation, normal
Q1, 2, S3
VIDEO sync normal
Check the sweep rotary switch
FRAME/LINE selector, normal
(X74-1350)
D15,16
Q17 ~ 25, D2 ~ 8
A sweep, normal
(X74-1350)
IC1a,b,d, 2a
(X77-1280)
D1
END


B TRIG
All signals of SOURCE normal
YES
NO
(X73-1520)
CH4 Trig amp (P18) Q15,16, D9
Check the LEVEL, SLOPE, COUPLING operations
Signal at P44 normal
(X77-1290)
Signal of Q2, normal
SOURCE switch COUPLING switch
Output of Q15 normal
Q3 ~ 15
B sweep, normal
(X74-1350)
IC4a,b,d, 5a
(X77-1290)
D2
END

PARTS LIST

This section includes a packing drawing with accompanying parts list, exploded views of the oscilloscope with accompanying mechanical parts list, and an electrical parts list referenced to the schematic diagram.

U.S.A. PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM:

B & K-Precision, Factory Service Department
Maxtec International Corporation
6470 West Cortland Street
Chicago, Illinois 60635
Tel (312) 889-1448

PACKING LIST

PARTS LIST FOR FIG. 12

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
301	Carton	500-629-9-001
302	Foam Cushion	502-138-9-001
303	Protective Pad	502-138-9-003
304	Probe Holder	251-528-9-001
305	Power Cord	420-030-9-001
306	Probe (Model PR-45)	534-045-0-000
307	Literature Package, Includes:	
	Instruction Manual	480-420-9-001
	Composite	499-309-9-001
	Warranty Card	491-199-9-001
	Factory Service List	492-036-0-000
	Spare Fuse, 1.2 A	191-017-9-001
	Plastic Bag	502-071-9-001

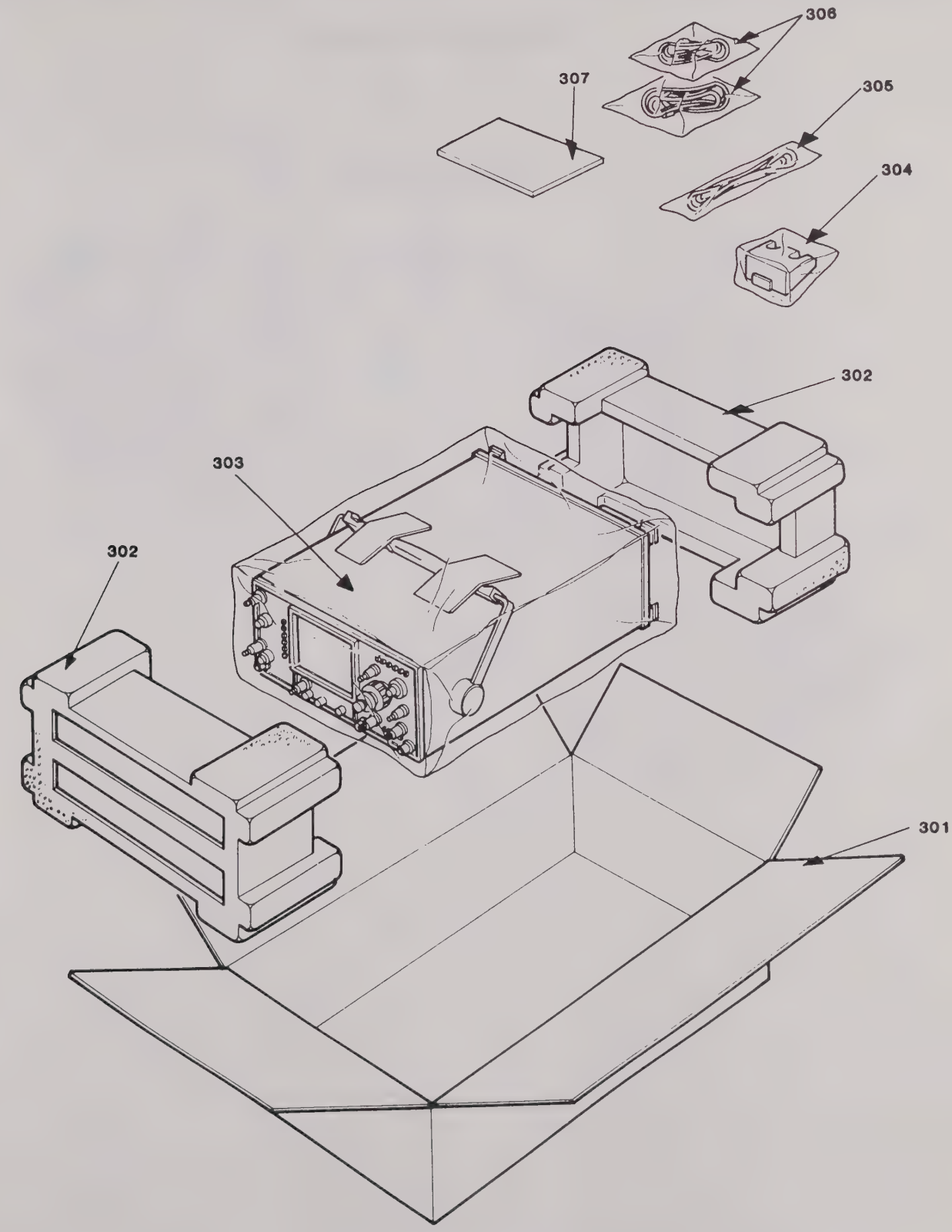


Fig. 12. Packing Drawing.

PARTS LIST FOR FIG. 13

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
201	Cord Wrap/Leg	380-338-9-006
202	Rear Escutcheon	769-115-9-003
203	Oscilloscope Case	272-170-9-001
204	Ring, for Handle	251-507-9-001
205	Gear, for Handle	251-506-9-001
206	Spring, for Handle	767-131-9-001
207	Cover, for Handle Hub	763-165-9-001
208	Handle	746-048-9-001
209	Rubber Foot	381-100-9-001
210	Protective Front Panel Cover (Optional Accessory)	Model LC-100

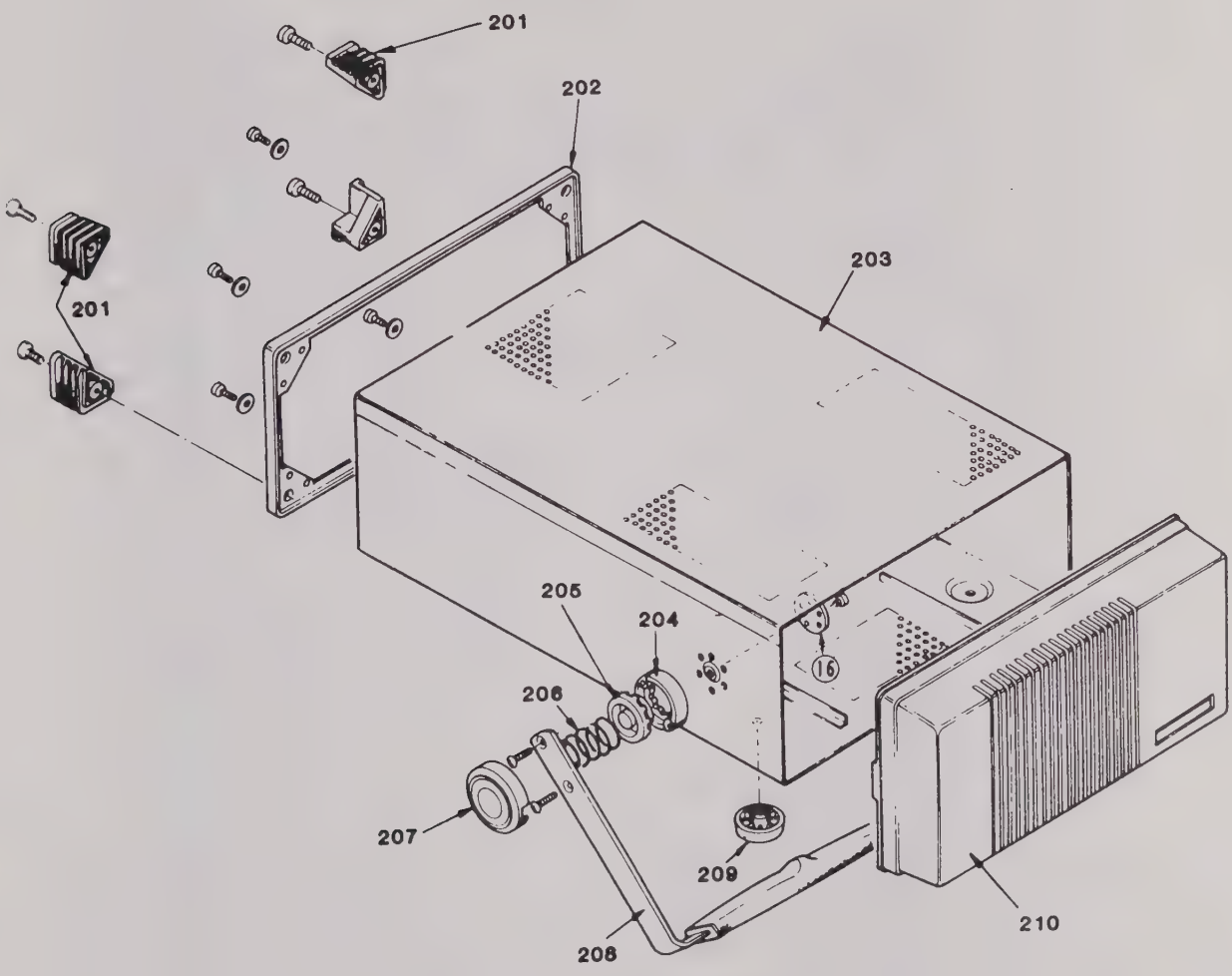


Fig. 13. Case Parts.

PARTS LIST FOR FIG. 14

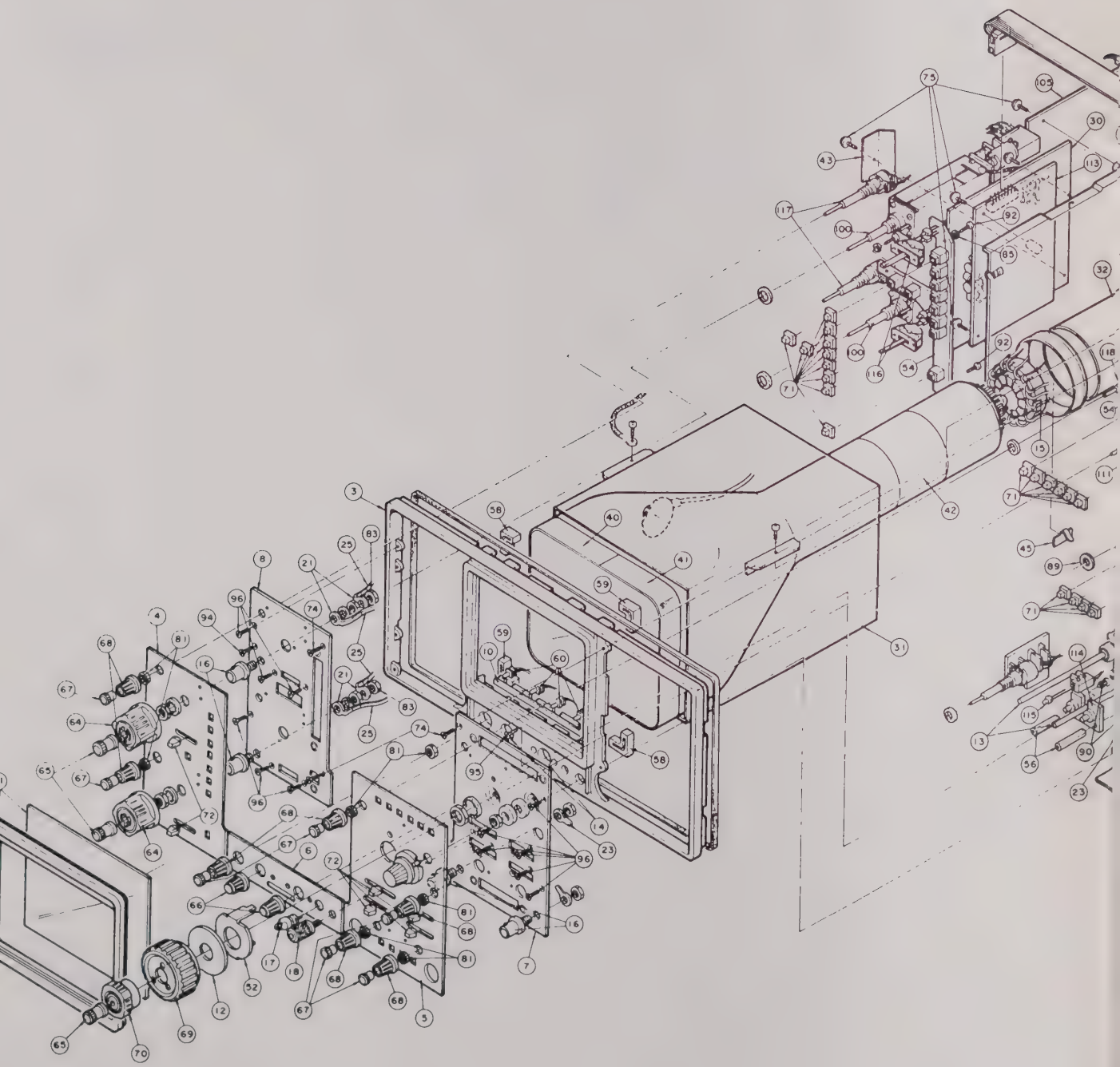
INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
1	Frame, LH	254-081-9-001
2	Frame, RH	254-082-9-001
3	Die-Cast Panel	255-234-9-001
4	Decorative Panel, CH 1, CH 2 (LH)	260-374-9-001
5	Decorative Panel, Sweep (RH)	260-375-9-001
6	Decorative Panel, Intensity (Center)	260-376-9-001
7	Sub-Panel (RH)	254-083-9-001
8	Sub-Panel (LH)	254-084-9-001
9	Rear Panel	262-054-9-001
10	Reflector (Illumination)	261-187-9-001
11	Filter	380-493-9-001
12	Scale (SWEEP TIME Switch)	380-496-9-002
13	Extension Shaft	763-194-9-001
14	Spacer	763-183-9-001
15	CRT Socket	749-088-9-001
16	BNC Receptacle, Jack	773-090-9-001
17	CAL Terminal	345-059-9-001
18	GND Terminal	345-065-9-001
19	Current Terminal	345-066-9-001
20	Ground Lug	740-009-9-001
21	Ground Lug	740-015-9-001
22	Ground Lug	740-026-9-001
23	Ground Lug	740-032-9-003
24	Ground Plate	740-040-9-001
25	Ground Lug	740-040-9-002
26	Fuse, 1.2 A	191-017-9-001
27	Shield Plate (for CH 3)	256-159-9-001
28	Shield Plate	256-185-9-001
29	Shield Plate (for Switch)	256-192-9-001
30	Shield Plate (for CPU)	256-192-9-002
31	Shield Case (for CRT)	256-192-9-003
32	Shield Case (for CRT)	256-192-9-004
33	Shield Case	256-192-9-005
36	Insulator (Current Terminal)	342-082-9-003
37	Insulator (for Blanking Board)	342-082-9-004
38	Insulator (Battery)	342-116-9-001
39	Insulator	342-113-9-001
40	Reflector Sheet (Left)	261-156-9-001
41	Reflector Sheet (Right)	261-158-9-001
42	Rubber Sheet	261-188-9-001
44	Fuse Holder	742-029-9-001
45	Cord Clamp	741-144-9-002
46	Cord Clamp	741-138-9-001
47	CRT Clamping Band	741-169-9-001
48	Cable Clamp	251-233-9-003
49	Delay Line Bracket	251-558-9-001
50	CRT Bracket	251-508-9-001
51	CRT Bracket	251-509-9-001
52	Locking Ring (SWEEP TIME Switch)	251-510-9-001
53	Bracket	251-584-9-001
54	PCB (Unmounted)	302-787-9-001

Parts List for Fig. 14 (continued)

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
55	Guide (CRT Mount)	261-157-9-001
56	Boss	759-175-9-001
57	Spacer (A, B Trigger Level)	759-116-9-002
58	Mounting Rubber (for CRT)	381-100-9-002
59	Mounting Rubber (for CRT)	381-100-9-003
60	Mounting Rubber (for Lamp)	381-100-9-004
61	Bushing	381-129-9-001
62	Wire Saddle	380-413-9-003
63	Saddle	380-493-9-003
64	Knob, VOLTS/DIV	751-288-9-001
65	Knob, VARIABLE	751-288-9-002
66	Knob, FOCUS, etc.	751-288-9-003
67	Knob, SLOPE, etc.	751-288-9-004
68	Knob, V. POSITION, etc.	751-288-9-005
69	Knob, A SWEEP TIME/DIV	751-288-9-006
70	Knob, B SWEEP TIME/DIV	751-288-9-007
71	Knob, Pushbutton	751-260-9-003
72	Knob, Lever Switch	751-288-9-008
73	Screw	634-147-9-002
74	Screw, Self Tapping, Flat Head, M3 x 18	634-147-9-008
75	Screw	634-156-9-002
76	Screw, Sems Pan Head	634-156-9-003
77	Screw	634-179-9-001
78	Screw	634-179-9-002
79	Nut, M3	653-068-9-001
80	Nut, M6	653-027-9-002
81	Nut	653-088-9-001
82	Nut, Knurled	653-068-9-003
83	Nut	653-088-9-002
84	Spring Washer	731-068-9-002
85	Spring Washer	731-068-9-003
86	Spring Washer	731-061-9-001
87	Lock Washer, M3	731-063-9-001
88	Insulator Washer	731-068-9-004
89	Flat Washer	731-060-9-001
90	Screw, Pan Head M2.6 x 6	634-123-9-003
92	Pan Head Screw, M3 x 6	634-054-9-003
93	Pan Head Screw, M3 x 8	634-123-9-004
94	Flat Head Screw, M2 x 6	634-179-9-003
95	Flat Head Screw, M2.6 x 6	634-106-9-001
96	Flat Head Screw, M3 x 6	634-054-9-007
97	Flat Head Screw, M3 x 8	634-157-9-001
98	Self Tapping Screw	710-051-9-001
99	Self Tapping Screw	710-087-9-001
100	Rotary Switch, VOLTS/DIV	083-301-9-001
101	Switching Power Supply (W02-0413-05)	157-028-9-001
102	High Voltage Block (W02-0414-05)	157-028-9-002
103	Power Supply & Blanking Assy (X68-1400-00)	523-570-9-001
104	Filter Unit (X70-1020-00)	523-571-9-001
105	Vertical Preamplifier Assy (X73-1500-00)	523-572-9-001
106	Vertical Output Amplifier Assy (X73-1510-00)	523-573-9-001

Parts List for Fig. 14 (continued)

INDEX NUMBER	DESCRIPTION	B & K-PRECISION PART NUMBER
107	CH3, CH4 Amplifier Assy (X73-1520-00)	523-574-9-001
108	Sweep Rotary Switch Assy (X74-1310-00)	523-575-9-001
109	Trigger & Sweep Assy (X74-1350-00)	523-576-9-001
110	Horizontal Output Amplifier Assy (X74-1360-00)	523-577-9-001
111	A Trigger Switch Assy (X77-1281-00)	523-578-9-001
112	B Trigger Switch Assy (X77-1290-00)	523-579-9-001
113	CPU Assy (X81-1320-00)	523-580-9-001
114	Astig Assy (X81-1430-00)	523-581-9-001
115	LED, Red (D8)	400-072-9-001
116	Lever Switch, AC-GND-DC (S23, S24)	080-015-9-001
117	Dual 5 kΩ Potentiometer, V POSITION Control (VR1, VR2)	008-482-9-001
118	Dual 5 kΩ Potentiometer with Rotary Switch, TRACE SEP/HOLDOFF (VR5)	008-406-9-003
119	Dual 5 kΩ Potentiometer with Push-Pull Switch, H POSITION Control	008-406-9-002
120	1 kΩ 10-Turn Potentiometer, DELAY TIME MULT Control	008-406-9-004



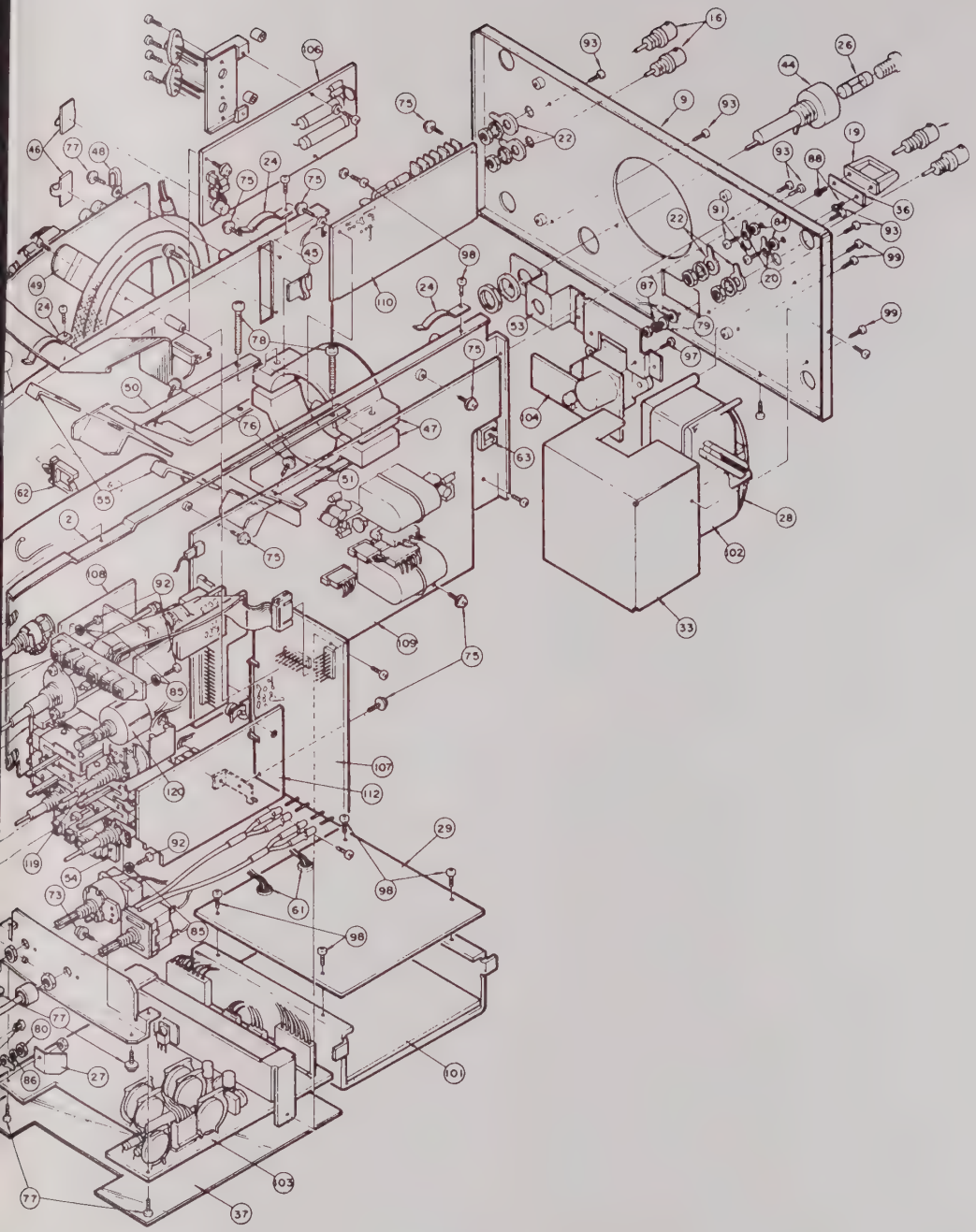


FIG. 14 EXPLODED VIEW

ELECTRICAL PARTS LIST

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	MAIN CHASSIS (Y70-1461-61)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.	
VR1, 2	Dual 1 kΩ Potentiometer, CH 1/CH 3 or CH 2/CH 4 POSITON Control	008-482-9-001
VR3, 4	Part of VERTICAL ATTENUATOR UNIT, CH 1 or CH 2 VARIABLE Controls	
VR5	Dual 5 kΩ Potentiometer with rotary switch, TRACE SEP/HOLDOFF Control	008-406-9-003
VR6	Dual 5 kΩ Potentiometer with push/pull switch, HORIZONTAL POSITION Control	008-406-9-002
VR7	1 kΩ Potentiometer, DELAY TIME MULT Control	008-406-9-004
	CAPACITORS	
C1, 2	0.047 µF ±10%, 630 V, Metal Film	033-042-9-003
C3, 4	0.01 µF,3 kV, Ceramic	033-077-9-001
	INDICATORS	
D1	LED, Red, CH 1 UNCAL Indicator	158-039-9-001
D2	LED, Green, CH 1 X5 GAIN Indicator	158-039-9-002
D3	LED, Red, CH 2 UNCAL Indicator	158-039-9-001
D4	LED, Green, CH 2 X5 GAIN Indicator	158-039-9-002
D5, 6	LED, Green, A TRIG'D, B TRIG'D Indicator	158-039-9-002
D7	LED, Red, A SWEEP UNCAL Indicator	158-039-9-001
D8	LED, Red, POWER Indicator	400-072-9-001
	SWITCHES	
S1-19	Pushbutton Switch Vertical MODE, HORIZ MODE, TRIG MODE, 20 MHz BW, CH 2 INV (19 used)	088-069-9-002
S20	Pushbutton Switch BEAM FIND	088-069-9-003
S21, 22	Part of VERTICAL ATTENUATOR UNIT	
S23, 24	Lever Switch, CH 1 or CH 2 INPUT COUPLING SWITCH	080-015-9-001
S25	Rotary Switch, B ENDS A Control, Part of VR5	
S26	Push Switch, PULL X10 MAG Control, Part of VR6	
S27, 28	Rotary Switch, CAL Control, Part of VERTICAL ATTENUATOR UNIT	
	VERTICAL ATTENUATOR UNIT	083-301-9-001
	MISCELLANEOUS	
CRT	150KTM31 Cathode Ray Tube	230-027-9-001
	CRT Socket	749-088-9-001
L1	Y Alignment Coil	041-148-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
L2	Delay Line	040-006-9-001
	BNC Receptacle, CH 1 OUT, SWEEP OUT, etc.	773-090-9-001
	Fuse, 1.2 A	191-017-9-001
	Fuse Holder	742-029-9-001
	CAL Terminal	345-059-9-001
	GND Terminal	345-065-9-001
	CURRENT Terminal	345-066-9-001
	UL-CSA Power Cord	420-030-9-001
	Insulator (for blanking)	342-082-9-004
	Insulator (for battery)	342-116-9-001
	Switching Power Supply (W02-0413-05)	157-028-9-001
	High Voltage Block (W02-0414-05)	157-028-9-002
	Lithium Battery, 3V, 0.2 AH	213-008-9-001

ASTIG UNIT
(X81-1430-00)

VR8	10 kΩ Potentiometer, TRACE ROTATION Control	008-482-9-004
VR9	150 kΩ Potentiometer, ASTIG Control	008-482-9-005

FILTER UNIT
(X70-1020-00)

RESISTORS

R1	220 kΩ ±5%, 1/2 W Carbon Film	002-102-5-224
R2	2.2 MΩ ±5%, 1/2 W Solid	002-102-5-225

CAPACITORS

C1	0.22 µF ±10%, 630 V, Polyester	033-077-9-002
C2, 3	1000 pF, 630 V, Ceramic	033-077-9-003
C4	1 µF ±20%, 50V, Electrolytic	022-226-9-017

MISCELLANEOUS

L1	Choke Coil	041-148-9-002
D1	GMA-01, Diode	151-111-9-001
IC1	ON3101, Photo Coupler	307-355-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C43	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C44	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C45	68 pF ±5%, 100 V, Mica	023-079-9-001
C46, 47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	4700 pF ±10%, 50 V, Ceramic	020-302-9-001
C49	Not Used	
C50-55	0.01 µF, 50 V, Ceramic	020-341-9-003
C56, 57	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
C58-61	0.01 µF, 50 V, Ceramic	020-341-9-003
C62	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C63	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
C64	12 pF ±5%, 50 V, Ceramic	020-167-9-002
C65-67	0.01 µF, 50 V, Ceramic	020-341-9-003
C68	47 pF ±5%, 50 V, Ceramic	020-144-9-004
C69, 70	0.01 µF, 50 V, Ceramic	020-341-9-003
C71, 72	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
C73, 74	10 pF ±0.5pF, 50 V, Ceramic	020-215-9-001
C75, 76	150 pF ±5%, 50 V, Ceramic	020-171-9-008
C77	0.01 µF, 50 V, Ceramic	020-341-9-003
C78, 79	Not Used	
C80-82	0.01 µF, 50 V, Ceramic	020-341-9-003
C83	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C84, 85	0.01 µF, 50 V, Ceramic	020-341-9-003
C86	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C87	0.01 µF, 50 V, Ceramic	020-341-9-003
C88-97	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C98	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C99	0.01 µF, 50 V, Ceramic	020-341-9-003
C100	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C101, 102	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C103-109	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C110	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C111	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C112, 113	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C114-118	0.01 µF, 50 V, Ceramic	020-341-9-003
C119	Not Used	
C120	0.01 µF, 50 V, Ceramic	020-341-9-003
C121, 122	220 pF ±5%, 50 V, Ceramic	020-283-9-008
C123, 124	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C125, 126	5 pF ±0.25pF, 50 V, Ceramic	020-233-9-002
C127	1 pF ±0.25pF, 50 V, Ceramic	020-250-9-001
C128	0.01 µF, 50 V, Ceramic	020-341-9-003
C129	2 pF ±0.25pF, 50 V, Ceramic	020-234-9-003
TC1	20 pF, Trimmer Capacitor	028-057-9-001
TC2, 3	10 pF, Trimmer Capacitor	028-054-9-001
TC4, 5	20 pF, Trimmer Capacitor	028-057-9-001
TC6-9	10 pF, Trimmer Capacitor	028-054-9-001
	INDUCTORS	
L1-10	4.7 µH, Ferrite	041-068-9-008
L11	100 µH, Ferrite	041-133-9-004
L12-18	4.7 µH, Ferrite	041-068-9-008
L19	Not Used	

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
L20-23	4.7 µH, Ferrite	041-068-9-008
	DIODES	
D1, 2	1S1544A	151-096-9-001
D3	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D4-10	GMA-01	151-111-9-001
D11, 12	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D13, 14	1S1544A	151-096-9-001
D15	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D16, 17	GMA-01	151-111-9-001
D18	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D19	1N60, Germanium	150-001-9-005
D20-24	GMA-01	151-111-9-001
D25	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D26	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D27	GMA-01	151-111-9-001
D28	MTZ7.5JA, 7.1 V Zener	152-136-9-004
D29-46	GMA-01	151-111-9-001
	TRANSISTORS	
Q1	J304, N-Channel FET	182-076-9-002
Q2-5	2SC2671(H), NPN Silicon	176-157-9-006
Q6, 7	2SC3354(T,S), NPN Silicon	176-157-9-004
Q8	2SC1733, NPN Silicon	176-157-9-005
Q9-13	2SC3315(C,D), NPN Silicon	176-157-9-003
Q14	2SC3311(R), NPN Silicon	176-157-9-002
Q15, 16	2SA1161, PNP Silicon	177-048-9-003
Q17	2SC3311(R), NPN Silicon	176-157-9-002
Q18, 19	2SA1323(B), PNP Silicon	177-071-9-002
Q20, 21	2SC3315(C,D), NPN Silicon	176-157-9-003
Q22-25	2SC2671(H), NPN Silicon	176-157-9-006
Q26, 27	2SC3315(C,D), NPN Silicon	176-157-9-003
Q28, 29	2SC3354(T,S), NPN Silicon	176-157-9-004
Q30	J304, N-Channel FET	182-076-9-002
Q31-34	2SC2671, NPN Silicon	176-157-9-006
Q35, 36	2SC3354(T,S), NPN Silicon	176-157-9-004
Q37	2SC1733, NPN Silicon	176-157-9-005
Q38-42	2SC3315(C,D), NPN Silicon	176-157-9-003
Q43	2SC3311, NPN Silicon	176-157-9-002
Q44-47	2SA1161, PNP Silicon	177-048-9-003
Q48	2SC3311(R), NPN Silicon	176-157-9-002
Q49, 50	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q51	2SC3311(R), NPN Silicon	176-157-9-002
Q52, 53	2SA1323(B), PNP Silicon	177-071-9-002
Q54, 55	2SC3315(C,D), NPN Silicon	176-157-9-003
Q56-59	2SC2671(H), NPN Silicon	176-157-9-006
Q60	2SC3315(C,D), NPN Silicon	176-157-9-003
Q61-63	2SC3354(T,S), NPN Silicon	176-157-9-004
Q64	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q65, 66	2SC3354(T,S), NPN Silicon	176-157-9-004
Q67, 68	2SA1161, PNP Silicon	177-048-9-003
Q69, 70	2SC3315(C,D), NPN Silicon	176-157-9-003
Q71	2SA1309(Q,R), PNP Silicon	177-071-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q72	2SC3311(R), NPN Silicon	176-157-9-002
Q73, 74	2SA1161, PNP Silicon	177-048-9-003
Q75	2SC3311(R), NPN Silicon	176-157-9-002
Q76, 77	2SC2671(H), NPN Silicon	176-157-9-006
Q78	2SC3311(R), NPN Silicon	176-157-9-002
Q79, 80	2SC2671(H), NPN Silicon	176-157-9-006
Q81	2SC3311(R), NPN Silicon	176-157-9-002
Q82 -85	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q86, 87	2SC3311(R), NPN Silicon	176-157-9-002
	INTEGRATED CIRCUITS	
IC1, 2	LF441ACN, Low Power JFET Op-Amp	307-355-9-003
IC3	SN7400N, Quad 2-input NAND Gate	307-106-9-004
IC4	MC10104L, Quad 2-input AND Gate	307-309-9-004
IC5	MC10131L, Dual D FLIP FLOP	307-309-9-005
IC6, 7	MC10102L, Quad 2-input NOR Gate	307-301-9-001
IC8	LM337LZ, Regulator	307-355-9-005
IC9	LM317LZ, Regulator	307-355-9-004

CHANNEL 3 AND 4 AMPLIFIER UNIT
(X73-1520-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.

R2	900 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-005
R3	111 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-004
R6	1 MΩ ±0.5%, 1/4 W, Metal Film	013-086-9-003
R16, 17	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R18, 19	1.1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-101
R20	680 Ω ±1%, 1/6 W, Metal Film	013-085-9-020
R21, 22	360 Ω ±1%, 1/6 W, Metal Film	013-085-9-027
R33	900 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-005
R34	111 kΩ ±0.5%, 1/4 W, Metal Film	013-086-9-004
R37	1 MΩ ±0.5%, 1/4 W, Metal Film	013-086-9-003
R47, 48	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R49, 50	1.1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-101
R51	680 Ω ±1%, 1/6 W, Metal Film	013-085-9-020
R52, 53	360 Ω ±1%, 1/6 W, Metal Film	013-085-9-027
VR1, 2	100 Ω Trimpot	008-434-9-002

CAPACITORS

C1	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C2, 3	0.01 µF, 50 V, Ceramic	020-341-9-003
C4	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C5	100 pF ±5%, 50 V, Ceramic	020-341-9-005
C6	5 pF ±0.25 pF, 50 V, Ceramic	020-233-9-002
C7	Not Used	
C8	39 pF ±5%, 50 V, Ceramic	020-341-9-004
C9, 10	0.01 µF, 50 V, Ceramic	020-341-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C11	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C12	100 pF ±5%, 50 V, Ceramic	020-341-9-005
C13	5 pF ±0.25 pF, 50 V, Ceramic	020-233-9-002
C14	Not Used	
C15-17	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C18 -23	0.01 µF, 50 V, Ceramic	020-341-9-003
C24, 25	Not Used	
C26-31	0.01 µF, 50 V, Ceramic	020-341-9-003
C32, 33	Not Used	
C34, 35	22 pF ±5%, 50 V, Ceramic	020-215-9-002
TC1	Not Used	
TC2	6 pF, Trimmer Capacitor	028-065-9-003
TC3	10 pF, Trimmer Capacitor	028-054-9-001
TC4	20 pF, Trimmer Capacitor	028-057-9-001
TC5	Not Used	
TC6	6 pF, Trimmer Capacitor	028-065-9-003
TC7	10 pF, Trimmer Capacitor	028-054-9-001
TC8	20 pF, Trimmer Capacitor	028-057-9-001
	INDUCTORS	
L1-3	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	GMA-01	151-111-9-001
D2	1S1544A	151-096-9-001
D3	GMA-01	151-111-9-001
D4	1S1544A	151-096-9-001
D5-9	GMA-01	151-111-9-001
	TRANSISTORS	
Q1	2SD438F, NPN Silicon	172-058-9-002
Q2	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q3, 4	2SC3354(T,S), NPN Silicon	176-157-9-004
Q5, 6	2SA1206, PNP Silicon	177-071-9-003
Q7, 8	2SC2671(H), NPN Silicon	176-157-9-006
Q9	2SD438(F), NPN Silicon	172-058-9-002
Q10	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q11, 12	2SC3354(T,S), NPN Silicon	176-157-9-004
Q13, 14	2SA1206, PNP Silicon	177-071-9-003
Q15, 16	2SC2671(H), NPN Silicon	176-157-9-006
	RELAYS	
RL1, 2	DPDT Relay	441-041-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	VERTICAL OUTPUT AMPLIFIER UNIT (X73-1510-00)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.	
R1	200 Ω ±1%, 1/6 W, Metal Film	015-164-2-000
R5, 6	75.0 Ω ±1%, 1/6 W, Metal Film	015-164-7-508
R10, 11	390 Ω ±1%, 1/4 W, Metal Film	013-076-9-001
R24, 25	68.0 Ω ±1%, 1/4 W, Metal Film	013-034-9-028
R31,32	560 Ω ±5%, 5 W, Metal Film	011-005-5-561
R37, 38	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R39	330 Ω ±1%, 1/6 W, Metal Film	013-085-9-014
R40	2 kΩ ±1%, 1/6 W, Metal Film	015-164-2-001
R41	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R43	47.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-024
R45	47.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-024
R46	91.0 Ω ±1%, 1/6 W, Metal Film	013-085-9-026
R47	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R48	2.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-023
VR1-3	500 Ω Trimpot	008-467-9-005
	CAPACITORS	
C1	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C2, 3	0.01 µF, 50 V, Ceramic	020-341-9-003
C4	220 pF ±5%, 50 V, Ceramic	020-124-9-008
C5	Not Used	
C6	12 pF ±5%, 50 V, Ceramic	020-167-9-002
C7	0.01 µF, 50 V, Ceramic	020-341-9-003
C8	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C9-11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12, 13	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C14	0.01 µF, 50 V, Ceramic	020-341-9-003
C15	33 µF ±20%, 35 V, Electrolytic	022-267-9-006
C16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C18	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C19, 20	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C21	Not Used	
C22	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C23	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C24, 25	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C26, 27	0.01 µF, 50 V, Ceramic	020-341-9-003
TC1, 2	20 pF, Trimmer Capacitor	028-065-9-004
	INDUCTORS	
L1, 2	Choke Coil	041-148-9-003
L3, 4	0.22 µH, Ferrite	041-133-9-009
L5-8	47 µH, Ferrite	041-143-9-002
	DIODES	
D1	MTZ24JC, 24 V Zener	152-136-9-005
D2, 3	1S2686	151-097-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	TRANSISTORS	
Q1, 2	2SC2671(H), NPN Silicon	176-157-9-006
Q3, 4	2SA1206, PNP Silicon	177-071-9-003
Q5, 6	2SC2671(H), NPN Silicon	176-157-9-006
Q7-10	2SC2644, NPN Silicon	176-114-9-008
Q11, 12	2SC1164, NPN Silicon	176-114-9-007
Q13	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q14	2SC3311(Q,R), NPN Silicon	176-157-9-007
Q15, 16	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q17	2SC3311(Q,R), NPN Silicon	176-157-9-007
Q18	2SA1309(Q,R), PNP Silicon	177-071-9-001
	MISCELLANEOUS	
TH1	SDT1000, Thermistor	005-003-9-002
	Bead Core	040-004-9-002

CPU UNIT
(X81-1320-00)

RESISTORS

Resistors are ±5%, 1/6 W. See schematic diagram for value.

	CAPACITORS	
C1	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C2	82 pF ±5%, 50 V, Ceramic	020-250-9-002
C3	2.2 µF ±20%, 50 V, Electrolytic	022-281-9-004
C4, 5	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
	DIODES	
D1-4	GMA-01	151-111-9-001
	TRANSISTORS	
Q1	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q2	2SC3311(R), NPN Silicon	176-157-9-002
	INTEGRATED CIRCUITS	
IC1	MTM5010, 4-Bit Microcomputer	307-355-9-013
IC2, 3	AN90B20, Transistor Array	307-355-9-012

A TRIGGER SWITCH UNIT
(X77-1280-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R9	47 kΩ ±1%, 1/6 W, Metal Film	013-085-9-017

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R10, 11	15 kΩ ±1%, 1/6 W, Metal Film	015-164-1-502
R12	47 kΩ ±1%, 1/6 W, Metal Film	013-085-9-017
R20, 21	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R27, 28	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R32, 33	270 Ω ±1%, 1/6 W, Metal Film	013-085-9-012
R30	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R31	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
VR1	100 kΩ Potentiometer, TRIG LEVEL Control	008-482-9-002
VR2	10 kΩ Trimpot	008-434-9-007
VR3	1 kΩ Trimpot	008-434-9-005
VR4	2 kΩ Trimpot	008-470-9-003
	CAPACITORS	
C1	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C2, 3	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C4, 5	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7, 8	7 pF ±0.5 pF, 50 V, Ceramic	020-149-9-001
C9	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C10, 11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12	Not Used	
C13	0.01 µF, 50 V, Ceramic	020-341-9-003
C14	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C15	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C16	Not Used	
C17	1 µF ±20%, 50 V, Electrolytic	022-167-9-001
C18	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C19	1 µF ±20%, 50 V, Electrolytic	022-226-9-017
C20	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
C21-24	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C25	Not Used	
C26-38	0.01 µF, 50 V, Ceramic	020-341-9-003
C39-41	Not Used	
C42	0.01 µF, 50 V, Ceramic	020-341-9-003
C43	Not Used	
C44, 45	0.01 µF, 50 V, Ceramic	020-341-9-003
C46	Not Used	
C47, 48	0.01 µF, 50 V, Ceramic	020-341-9-003
C49	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
TC1	20 pF Trimmer Capacitor	028-065-9-001
	INDUCTORS	
L1, 2	100 µH, Ferrite	041-124-9-001
	DIODES	
D1	SV03Y	153-022-9-001
D2, 3	GMA-01	151-111-9-001
D4	MTZ16JA, 15 V Zener	152-134-9-002
D5-8	GMA-01	151-111-9-001
D9	SV04Y	153-026-9-001
	TRANSISTORS	
Q1	2SJ43(Q), P-Channel FET	182-064-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q2	2SK127(Q), FET	182-064-9-002
Q3	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q4, 5	2SC3354(T,S), NPN Silicon	176-157-9-004
Q6, 7	2SA1161, PNP Silicon	177-048-9-003
Q8	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q9	2SC3066, NPN Silicon	176-157-9-008
Q10, 11	2SC2671(H), NPN Silicon	176-157-9-006
Q12-15	2SC3354(T,S), NPN Silicon	176-157-9-004
Q16	2SC2671(H), NPN Silicon	176-157-9-006
Q17	2SC3311(R), NPN Silicon	176-157-9-002
Q18	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q19	2SK30A(O), N-Channel FET	182-040-9-001
Q20	2SC3311(R), NPN Silicon	176-157-9-002
Q21	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q22	2SC3311(R), NPN Silicon	176-157-9-002
Q23	2SA3109(Q,R), PNP Silicon	177-071-9-001
Q24	2SK30A(O), N-Channel FET	182-040-9-001
Q25	2SA3109(Q,R), PNP Silicon	177-071-9-001
	MISCELLANEOUS	
S1	6 Positon Lever Switch, Trigger SOURCE Control	080-024-9-001
S2	5 Position Lever Switch, Trigger COUPLING Control	080-003-9-002
	Bead Core	040-004-9-002

B TRIGGER SWITCH UNIT
(X77-1290-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R16, 17	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R23, 24	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R26, 27	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R28, 29	270 Ω ±1%, 1/6 W, Metal Film	013-085-9-012
VR1	100 kΩ Potentiometer, TRIG LEVEL Control	008-482-9-003
VR2	10 kΩ Trimpot	008-434-9-007
VR3	2 kΩ Trimpot	008-470-9-003

CAPACITORS

C1	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C2	0.01 µF ±20%, 630 V, Metal Film	033-023-9-002
C3, 4	68 pF ±5%, 50 V, Ceramic	020-215-9-008
C5, 6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7, 8	7 pF ±0.5 pF, 50 V, Ceramic	020-337-9-004
C9	0.01 µF, 50 V, Ceramic	020-341-9-003
C10	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C11-16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C18-23	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C24-35	0.01 µF, 50 V, Ceramic	020-341-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C36, 37	1000 pF ±10%, 50 V, Ceramic	020-249-9-001
TC1	20 pF Trimmer Capacitor	028-065-9-004
	INDUCTORS	
L1, 2	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	MTZ8.2JB, 8.1 V Zener	152-136-9-007
D2	SV03Y	153-022-9-001
D3	SV04Y	153-026-9-001
	TRANSISTORS	
Q1	2SC3354(T,S), NPN Silicon	176-157-9-004
Q2	DN1901, Dual Silicon N-Channel FET	182-070-9-001
Q3, 4	2SC3354(T,S), NPN Silicon	176-157-9-004
Q5, 6	2SA1161, PNP Silicon	177-048-9-003
Q7	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q8	2SC3066, NPN Silicon	176-157-9-008
Q9, 10	2SC2671(H), NPN Silcon	176-157-9-006
Q11-14	2SC3354(T,S), NPN Silicon	176-157-9-004
Q15	2SC2671(H), NPN Silicon	176-157-9-006
	MISCELLANEOUS	
S1, 2	4 Position Lever Switch, B Trigger COUPLING and SOURCE Controls	080-004-9-002
	Bead Core	040-004-9-002

SWEEP ROTARY UNIT
(X74-1310-00)

	RESISTORS	
	Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.	
R1	360 kΩ ±1%, 1/8 W, Metal Film	013-087-9-005
R2	120 kΩ ±1%, 1/8 W, Metal Film	013-087-9-002
R3, 4	30 kΩ ±1%, 1/8 W, Metal Film	013-073-9-005
R5	36 kΩ ±1%, 1/8 W, Metal Film	013-087-9-004
R6	12 kΩ ±1%, 1/8 W, Metal Film	013-087-9-001
R7, 8	3 kΩ ±1%, 1/8 W, Metal Film	013-052-9-023
R9	3.6 kΩ ±1%, 1/8 W, Metal Film	013-087-9-003
R20	360 kΩ ±1%, 1/8 W, Metal Film	013-087-9-005
R21	120 kΩ ±1%, 1/8 W, Metal Film	013-087-9-002
R22, 23	30 kΩ ±1%, 1/8 W, Metal Film	013-073-9-005
R24	36 kΩ ±1%, 1/8 W, Metal Film	013-087-9-004
R25	12 kΩ ±1%, 1/8 W, Metal Film	013-087-9-001
R26, 27	3 kΩ ±1%, 1/8 W, Metal Film	013-052-9-023
R28	3.6 kΩ ±1%, 1/8 W, Metal Film	013-087-9-003
	CAPACITORS	
C1-4	0.01 µF ±10%, 50 V, Ceramic	020-296-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	DIODES	
D1	GMA-01	151-111-9-001
D2-8	1SS135	151-118-9-001
D9	GMA-01	151-111-9-001
D10-16	1SS135	151-118-9-001
	SWITCHES	
S1-4	Rotary Switch, SWEEP TIME/DIV control	083-289-9-001

TRIGGER SWEEP UNIT
(X74-1350-00)

RESISTORS

Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.

R34	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R35, 36	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R38	24 kΩ ±1%, 1/6 W, Metal Film	013-085-9-030
R39	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R40	12 kΩ ±1%, 1/6 W, Metal Film	013-085-9-028
R41	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R43	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R45	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R91	510 Ω ±1%, 1/6 W, Metal Film	013-085-9-033
R92, 93	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R150	7.5 kΩ ±1%, 1/6 W, Metal Film	015-164-7-501
R151	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R152	2.4 kΩ ±1%, 1/6 W, Metal Film	013-085-9-022
R154	24 kΩ ±1%, 1/6 W, Metal Film	013-085-9-030
R155	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R156	12 kΩ ±1%, 1/6 W, Metal Film	013-085-9-028
R157	1.5 kΩ ±1%, 1/6 W, Metal Film	015-164-1-501
R159	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R161	3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-013
R199	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R201	6.8 kΩ ±1%, 1/6 W, Metal Film	013-085-9-035
R203	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R205	6.8 kΩ ±1%, 1/6 W, Metal Film	013-085-9-035
R206	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R207	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R208	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R209	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R213	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R214	2 kΩ ±1%, 1/6 W, Metal Film	015-164-2-001
R215	4.7 kΩ ±1%, 1/6 W, Metal Film	013-085-9-025
R219	3.3 kΩ ±1%, 1/6 W, Metal Film	013-085-9-032
R220	6.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-034
R224, 225	470 Ω ±1%, 1/6 W, Metal Film	013-085-9-016
R227, 228	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R229, 230	1.6 kΩ ±1%, 1/6 W, Metal Film	013-085-9-029

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R233, 234	1 kΩ ±1%, 1/6 W, Metal Film	015-164-1-001
R235	150 Ω ±1%, 1/6 W, Metal Film	015-164-1-500
R236, 237	820 Ω ±1%, 1/6 W, Metal Film	013-085-9-036
R302	91 kΩ ±1%, 1/6 W, Metal Film	013-085-9-037
R303	100 kΩ ±1%, 1/6 W, Metal Film	015-164-1-003
R307	300 Ω ±1%, 1/6 W, Metal Film	013-085-9-031
R308	100 Ω ±1%, 1/6 W, Metal Film	015-164-1-000
VR1	10 kΩ Trimpot	008-467-9-008
VR2	5 kΩ Trimpot	008-434-9-013
VR3	10 kΩ Trimpot	008-467-9-008
VR4	5 kΩ Trimpot	008-434-9-013
VR5	200 Ω Trimpot	008-434-9-001
VR6	5 kΩ Trimpot	008-434-9-013
VR7, 8	1 kΩ Trimpot	008-434-9-012
VR9, 10	5 kΩ Trimpot	008-434-9-013
VR11, 12	2 kΩ Trimpot	008-434-9-011
VR13	100 Ω Trimpot	008-434-9-002
VR14	500 Ω Trimpot	008-434-9-003
VR15	10 kΩ Trimpot	008-467-9-008
VR16	100 kΩ Trimpot	008-467-9-006
VR17	200 Ω Trimpot	008-434-9-001
	CAPACITORS	
C1	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C2, 3	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C4	0.01 µF, 50 V, Ceramic	020-341-9-003
C5	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C6	0.01 µF, 50 V, Ceramic	020-341-9-003
C7	22 µF ±20%, 35 V, Electrolytic	022-281-9-002
C8	0.01 µF, 50 V, Ceramic	020-341-9-003
C9	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C10, 11	0.01 µF, 50 V, Ceramic	020-341-9-003
C12	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
C13	10 µF ±10%, Plastic	033-077-9-005
C14, 15	0.01 µF, 50 V, Ceramic	020-341-9-003
C16	0.033 µF ±10%, 50 V, Mylar	025-056-9-004
C17	0.1 µF ±5%, Ceramic	033-077-9-006
C18, 19	0.01 µF, 50 V, Ceramic	020-341-9-003
C20	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C21	1000 pF ±10%, Ceramic	033-077-9-004
C22	0.01 µF, 50 V, Ceramic	020-341-9-003
C23	120 pF ±5%, 100 V, Mica	023-085-9-001
C24	0.01 µF, 50 V, Ceramic	020-341-9-003
C25	120 pF ±5%, 50 V, Ceramic	020-103-9-001
C26	Not Used	
C27	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C28, 29	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C30	0.01 µF, 50 V, Ceramic	020-341-9-003
C31	33 pF ±5%, 50 V, Ceramic	020-111-9-005
C32, 33	10 µF ±20%, 25 V, Electrolytic	022-281-9-003
C34	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C35	0.01 µF, 50 V, Ceramic	020-341-9-003
C36	22 µF ±20%, 35 V, Electrolytic	022-281-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C37	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C38, 39	0.01 µF, 50 V, Ceramic	020-341-9-003
C40	3.3 µF ±20%, 50 V, Electrolytic	022-226-9-009
C41	10 µF ±10%, Plastic	033-077-9-005
C42, 43	0.01 µF, 50 V, Ceramic	020-341-9-003
C44	0.033 µF ±10%, 50 V, Mylar	025-056-9-004
C45	0.1 µF ±5%, Ceramic	033-077-9-006
C46, 47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	330 pF ±5%, 50 V, Ceramic	020-158-9-004
C49	1000 pF ±10%, Ceramic	033-077-9-004
C50, 51	0.01 µF, 50 V, Ceramic	020-341-9-003
C52	120 pF ±5%, 50 V, Ceramic	020-103-9-001
C53	120 pF ±5%, 100 V, Mica	023-085-9-001
C54	0.01 µF, 50 V, Ceramic	020-341-9-003
C55	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C56	10 µF ±20%, 16 V, Electrolytic	022-226-9-014
C57, 58	0.01 µF, 50 V, Ceramic	020-341-9-003
C59	680 pF ±10%, 50 V, Ceramic	020-200-9-003
C60	47 pF ±5%, 100 V, Mica	023-056-9-002
C61	39 pF ±5%, 100 V, Mica	023-059-9-001
C62	22 pF ±5%, 50 V, Ceramic	020-124-9-007
C63, 64	1000 pF ±5%, 50 V, Mylar	025-219-9-001
C65	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C66, 67	4700 pF ±5%, 50 V, Mylar	025-153-9-003
C68	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C69	470 pF ±5%, 50 V, Ceramic	020-233-9-003
C70-72	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C73-75	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C76	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C77	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C78	0.01 µF, 50 V, Ceramic	020-341-9-003
C79	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C80	100 µF ±20%, 16 V, Electrolytic	022-225-9-002
C81-84	0.01 µF, 50 V, Ceramic	020-341-9-003
C85	47 µF ±20%, 10 V, Electrolytic	022-267-9-005
C86-88	100 µF ±20%, 10 V, Electrolytic	022-264-9-009
C89	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C90, 91	0.01 µF, 50 V, Ceramic	020-341-9-003
C92-103	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C104-106	22 µF ±20%, 25 V, Electrolytic	022-264-9-001
C107	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C108	0.01 µF, 50 V, Ceramic	020-341-9-003
C109	33 µF ±20%, 25 V, Electrolytic	022-276-9-003
C110	4.7 µF ±20%, 63 V, Electrolytic	022-226-9-010
C111	10 µF ±20%, 63 V, Electrolytic	022-244-9-002
C112-114	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C115	Not Used	
C116	47 µF ±20%, 16 V, Electrolytic	022-281-9-001
C117	22 pF ±5%, 50 V, Ceramic	020-124-9-007
C118	330 pF ±5%, 50 V, Ceramic	020-158-9-004
TC1, 2	40 pF Trimmer Capacitor	028-069-9-001
TC3, 4	6 pF Trimmer Capacitor	028-065-9-003

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	INDUCTORS	
L1, 2	10 µH, Ferrite	041-133-9-003
L3	22 µH, Ferrite	041-089-9-001
	DIODES	
D1	Not Used	
D2-4	GMA-01	151-111-9-001
D5	MTZ3.0JB, 3.0 V Zener	152-136-9-006
D6	GMA-01	151-111-9-001
D7	DS442X, Silicon Switching	151-097-9-001
D8	GMA-01	151-111-9-001
D9	DS442X, Silicon Switching	151-097-9-001
D10, 11	GMA-01	151-111-9-001
D12	DS442X, Silicon Switching	151-097-9-001
D13	MTZ16JA, 15 V Zener	152-134-9-002
D14-21	GMA-01	151-111-9-001
D22	Not Used	
D23-30	GMA-01	151-111-9-001
D31	Not Used	
D32-36	GMA-01	151-111-9-001
D37	DS442X, Silicon Switching	151-097-9-001
D38	GMA-01	151-111-9-001
D39	DS442X, Silicon Switching	151-097-9-001
D40, 41	GMA-01	151-111-9-001
D42	DS442X, Silicon Switching	151-097-9-001
D43	MTZ16JA, 15 V Zener	152-134-9-002
D44	MTZ3.0JB, 3.0 V Zener	152-136-9-006
D45-52	GMA-01	151-111-9-001
D53, 54	MTZ12JC, 12 V Zener	152-136-9-001
D55	SV06Y	153-019-9-001
D56-59	GMA-01	151-111-9-001
D60	SV06Y	153-019-9-001
D61-69	GMA-01	151-111-9-001
D70	Not Used	
D71, 72	GMA-01	151-111-9-001
D73	1N60, Germanium	150-001-9-005
	TRANSISTORS	
Q1-3	2SC3311(R), NPN Silicon	176-157-9-002
Q4	2SA1323(B), PNP Silicon	177-071-9-002
Q5	2SC3354(T,S), NPN Silicon	176-157-9-004
Q6	2SC1973(T), NPN Silicon	176-099-9-002
Q7	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q8	2SD438(F), NPN Silicon	172-058-9-002
Q9-17	2SC3311(R), NPN Silicon	176-157-9-002
Q18	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q19	2SC3315(C,D), NPN Silicon	176-157-9-003
Q20	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q21	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q22	2SC3315(C,D), NPN Silicon	176-157-9-003
Q23-26	2SC3311(R), NPN Silicon	176-157-9-002
Q27-30	2SA1323(B), PNP Silicon	177-071-9-002
Q31-33	2SC3311(R), NPN Silicon	176-157-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q34	2SA1323(B), PNP Silicon	177-071-9-002
Q35	2SC3354(T,S), NPN Silicon	176-157-9-004
Q36	2SC1973(T), NPN Silicon	176-099-9-002
Q37	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q38	2SD438(F), NPN Silicon	172-058-9-002
Q39-47	2SC3311(R), NPN Silicon	176-157-9-002
Q48	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q49	2SC3315(C,D), NPN Silicon	176-157-9-003
Q50	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q51	M47F(C), Dual Silicon N-Channel FET	182-071-9-001
Q52	2SC3315(C,D), NPN Silicon	176-157-9-003
Q53, 54	2SC3311(R), NPN Silicon	176-157-9-002
Q55-61	2SC3315(C,D), NPN Silicon	176-157-9-003
Q62	2SA1239(F), Dual PNP Silicon	177-068-9-001
Q63	Not Used	
Q64-67	2SC3315(C,D), NPN Silicon	176-157-9-003
Q68, 69	2SC3311(R), NPN Silicon	176-157-9-002
Q70, 71	2SC3315(C,D), NPN Silicon	176-157-9-003
Q72	2SA1323(B), PNP Silicon	177-071-9-002
Q73	2SC3354(T,S), NPN Silicon	176-157-9-004
Q74	2SA1323(B), PNP Silicon	177-071-9-002
Q75	2SC3354(T,S), NPN Silicon	176-157-9-004
Q76	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q77	2SA1323(B), PNP Silicon	177-071-9-002
Q78	2SC3311(R), NPN Silicon	176-157-9-002
Q79-82	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q83, 84	2SA1323(B), PNP Silicon	177-071-9-002
	INTEGRATED CIRCUITS	
IC1	MC10H103L, Quad 2-Input OR GATE	307-355-9-007
IC2	MC10H131L, Dual D-Flip Flop	307-355-9-008
IC3	LF412CN, Dual JFET Input Op-Amp	307-355-9-006
IC4	MC10H103L, Quad 2-Input OR GATE	307-355-9-007
IC5	MC10H131L, Dual D-Flip Flop	307-355-9-008
IC6	LF412CN, Dual JFET Input Op-Amp	307-355-9-006
IC7	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC8	MC10103L, Quad 2-Input OR GATE	307-309-9-003
IC9-11	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC12	MC10102L, Quad 2-Input NOR GATE	307-301-9-001
IC13	MC10131L, Dual D-Flip Flop	307-309-9-005
IC14	SN7406, Hex Open Collector Inverters	307-355-9-011
IC15	MC10104L, Quad 2-Input AND GATE	307-309-9-004
IC16	MC78L05CP, Voltage Regulator, 5 V, 100 mA	307-355-9-009
IC17	MC78L15ACP, Voltage Regulator, 5 V, 100 mA	307-355-9-010

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
	HORIZONTAL OUTPUT AMP UNIT (X74-1360-00)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 W. See schematic diagram for value.	
R6, 7	47 kΩ ±5%, 1/2 W, Carbon Film	002-102-5-473
R12, 13	22 kΩ ±5%, 1 W, Metal Film	011-001-5-223
R16	12 kΩ ±5%, 1/2 W, Carbon Film	002-102-5-123
	CAPACITORS	
C1	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C2-5	0.01 µF, 50 V, Ceramic	020-341-9-003
C6 -9	1 pF ± 0.25 pF, 500 V, Ceramic	020-326-9-002
C10	0.01 µF, 50 V, Ceramic	020-341-9-003
C11-13	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C14	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C15	0.01 µF, 50 V, Ceramic	020-341-9-003
C16	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C17	4700 pF ± 10%, 500 V, Ceramic	020-302-9-003
C18	0.01 µF, 50 V, Ceramic	020-341-9-003
C19, 20	100 µF ± 20%, 16 V, Electrolytic	022-222-9-014
C21	10 µF ± 20%, 100 V, Electrolytic	021-069-9-002
C22	2.2 µF, 160 V, Electrolytic	021-077-9-001
C23	0.01 µF, 50 V, Ceramic	020-341-9-003
C24	7 pF ± 0.5 pF, 50 V, Ceramic	020-149-9-001
	INDUCTORS	
L1-4	100 µH, Ferrite	041-133-9-004
	DIODES	
D1	DS442X, Silicon Switching	151-097-9-001
D2	MTZ5.1JB, 5 V Zener	152-134-9-003
	TRANSISTORS	
Q1-4	2SA1323(B), PNP Silicon	177-071-9-002
Q5, 6	2SC805A-2(2,3), NPN Silicon	176-114-9-002
Q7, 8	2SA923-2(2,3), PNP Silicon	177-041-9-001
Q9-11	2SC331(R), NPN Silicon	176-157-9-002
	POWER BLANKING UNIT (X68-1400-00)	
	RESISTORS	
	Unlisted resistors are ±5%, 1/6 or 1/4 W. See schematic diagram for value.	
R6	130 kΩ ±1%, 1/6 W, Metal Film	015-164-1-303
R7	5.6 kΩ ±1%, 1/6 W, Metal Film	013-085-9-006
R10, 11	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R12	100 Ω ±1%, 1/6 W, Metal Film	015-164-1-000

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
R15	1.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-001
R16	3.9 kΩ ±1%, 1/6 W, Metal Film	013-085-9-004
R19	220 Ω ±1%, 1/6 W, Metal Film	013-085-9-002
R20	5.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-005
R22	13 kΩ ±1%, 1/6 W, Metal Film	015-164-1-302
R23	8.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-008
R32	2.2 kΩ ±1%, 1/6 W, Metal Film	013-085-9-003
R33	9.1 kΩ ±1%, 1/6 W, Metal Film	013-085-9-009
R68	62 kΩ ±1%, 1/6 W, Metal Film	013-085-9-007
R74	15 MΩ ±5%, 1/2 W, Fixed	004-193-9-002
R75	5.1 MΩ ±5%, 1/2 W, Fixed	004-211-9-001
R76	4.7 MΩ ±5%, 1 W, Fixed	004-211-9-002
R77	4.3 MΩ ±5%, 1 W, Fixed	004-211-9-003
R78	3 MΩ ±5%, 1/2 W, Fixed	004-193-9-001
R79	47 MΩ ±5%, 1/2 W, Fixed	004-181-9-002
VR1	4.7 kΩ, Trimpot	008-298-9-009
VR2	10 kΩ, Trimpot	008-298-9-010
VR3	47 kΩ, Trimpot	008-298-9-012
VR4	3 MΩ, Potentiometer, FOCUS control	008-390-9-001
VR5	10 kΩ, Potentiometer, SCALE ILLUM control	008-406-9-006
VR6	1 kΩ, Potentiometer, A INTENSITY, B INTENSITY control	008-406-9-005
	CAPACITORS	
C1, 2	0.01 µF, 50 V, Ceramic	020-341-9-003
C3	10 µF ±20%, 35 V, Electrolytic	022-226-9-003
C4	33 µF ±20%, 63 V, Electrolytic	022-226-9-005
C5, 6	3.3 µF, 160 V, Electrolytic	021-074-9-001
C7	33 µF ±20%, 16 V, Electrolytic	022-226-9-008
C8	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C9, 10	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C11	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C12	10 µF ±20%, 35 V, Electrolytic	022-226-9-003
C13	0.01 µF, 50 V, Ceramic	020-341-9-003
C14	47 µF ±20%, 35 V, Electrolytic	022-226-9-004
C15, 16	0.01 µF, 50 V, Ceramic	020-341-9-003
C17, 18	100 pF ±5%, 50 V, Ceramic	020-341-9-001
C19, 20	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C21, 22	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C23	0.1 µF ±20%, 12 V, Ceramic	033-018-9-001
C24	0.5 pF ±0.25 pF, 500 V, Ceramic	020-341-9-002
C25	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C26	1 µF ±20%, 35 V, Tantalum	033-054-9-001
C27	3 pF ±0.25 pF, 500 V, Ceramic	020-326-9-008
C28	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C29	0.01 µF, 50 V, Ceramic	020-341-9-003
C30	3.3 µF, 160 V, Electrolytic	021-074-9-001
C31	4700 pF ±10%, 500 V, Ceramic	020-302-9-003
C32	220 µF ±20%, 10 V, Electrolytic	022-225-9-001
C33	0.01 µF, 50 V, Ceramic	020-341-9-003
C34	100 µF ±20%, 25 V, Electrolytic	022-226-9-002
C35	0.01 µF, 50 V, Ceramic	020-341-9-003
C36-39	0.01 µF ±0.25 pF, 3 kV, Ceramic	033-077-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C40	1000 pF, 3.1 kV, Ceramic	020-226-9-003
C41	0.15 µF ±10%, 50 V, Mylar	025-192-9-001
C42, 43	0.01 µF, 50 V, Ceramic	020-341-9-003
C44	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C45	0.01 µF, 50 V, Ceramic	020-341-9-003
C46	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C47	0.01 µF, 50 V, Ceramic	020-341-9-003
C48	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C49	4700 pF ±10%, 50 V, Mylar	025-107-9-007
C50	47 µF ±20%, 25 V, Electrolytic	022-226-9-001
C51	0.01 µF, 50 V, Ceramic	020-341-9-003
C52, 53	0.01 µF ±0.25 pF, 3 kV, Ceramic	033-077-9-001
C54	1000 pF, 2 kV, Ceramic	020-226-9-002
C55	2200 pF ±10%, 500 V, Ceramic	020-302-9-004
C56-58	Not Used	
C59, 60	0.01 µF, 50 V, Ceramic	020-341-9-003
C61	47 µF ±20%, 16 V, Electrolytic	022-226-9-012
TC1, 2	20 pF Trimmer Capacitor	028-050-9-002
TC3	2 pF Trimmer Capacitor	028-079-9-001
	INDUCTORS	
L1-5	100 µH, Ferrite	041-133-9-004
L6	100 µH, Ferrite	041-124-9-001
L7, 8	100 µH, Ferrite	041-133-9-004
	DIODES	
D1	DS442X, Silicon Switching	151-097-9-001
D2, 3	MTZ12JC, 12 V Zener	152-136-9-001
D4	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D5	DS442X, Silicon Switching	151-097-9-001
D6, 7	Not Used	
D8	DS442X, Silicon Switching	151-097-9-001
D9	MTZ5.1JB, 5 V Zener	152-134-9-003
D10, 11	1SS83, Silicon Switching	151-084-9-001
D12-15	W06C, Silicon Rectifier	151-052-9-002
D16, 17	DS442X, Silicon Switching	151-097-9-001
D18	MTZ3.3JA, 3.2 V Zener	152-136-9-002
D19	MTZ6.2JB, 6.1 V Zener	152-136-9-003
D20	DS442X, Silicon Switching	151-097-9-001
	TRANSITORS	
Q1	2SC2591(Q,R), NPN Silicon	176-157-9-001
Q2	2SC1505(L), NPN Silicon	172-058-9-001
Q3	2SB633(E), PNP Silicon	173-010-9-001
Q4	2SD613(E), NPN Silicon	176-104-9-002
Q5	2SB633(E), PNP Silicon	173-010-9-001
Q6	2SC1505(L), NPN Silicon	172-058-9-001
Q7	2SC3311(R), NPN Silicon	176-157-9-002
Q8	2SC1505(L), NPN Silicon	172-058-9-001
Q9	2SC3311(R), NPN Silicon	176-157-9-002
Q10	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q11, 12	2SC3354(T,S), NPN Silicon	176-157-9-004
Q13	2SA1323(B), PNP Silicon	177-071-9-002

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
Q14	2SC3311(R), NPN Silicon	176-157-9-002
Q15-17	2SC3315(C,D), NPN Silicon	176-157-9-003
Q18	2SC805A-2(2,3), NPN Silicon	176-114-9-002
Q19	2SA923-2(2,3), PNP Silicon	177-041-9-001
Q20	2SC2910(S,T), NPN Silicon	176-126-9-001
Q21	2SA1208(S,T), PNP Silicon	177-053-9-001
Q22, 23	2SC2910(S,T), NPN Silicon	176-126-9-001
Q24, 25	2SC3311(R), NPN Silicon	176-157-9-002
Q26	2SA1309(Q,R), PNP Silicon	177-071-9-001
Q27	2SK192A-BL, N-Channel FET	182-076-9-001
Q28	2SD613(E), NPN Silicon	176-104-9-002
	INTEGRATED CIRCUITS	
IC1, 2	NJM4558D, Dual Op-Amp	307-333-9-001
IC3	LM340LAZ5.0, Regulator	307-355-9-001
	MISCELLANEOUS	
NL1-4	Neon Lamp	401-024-9-001
PL1-4	Lamp	400-082-9-001
	Neon Tube Holder	253-117-9-001

SWITCHING POWER SUPPLY
(W02-0413-05)

RESISTORS

Unlisted resistors are ±5%, 1/4 W. See schematic diagram for value.

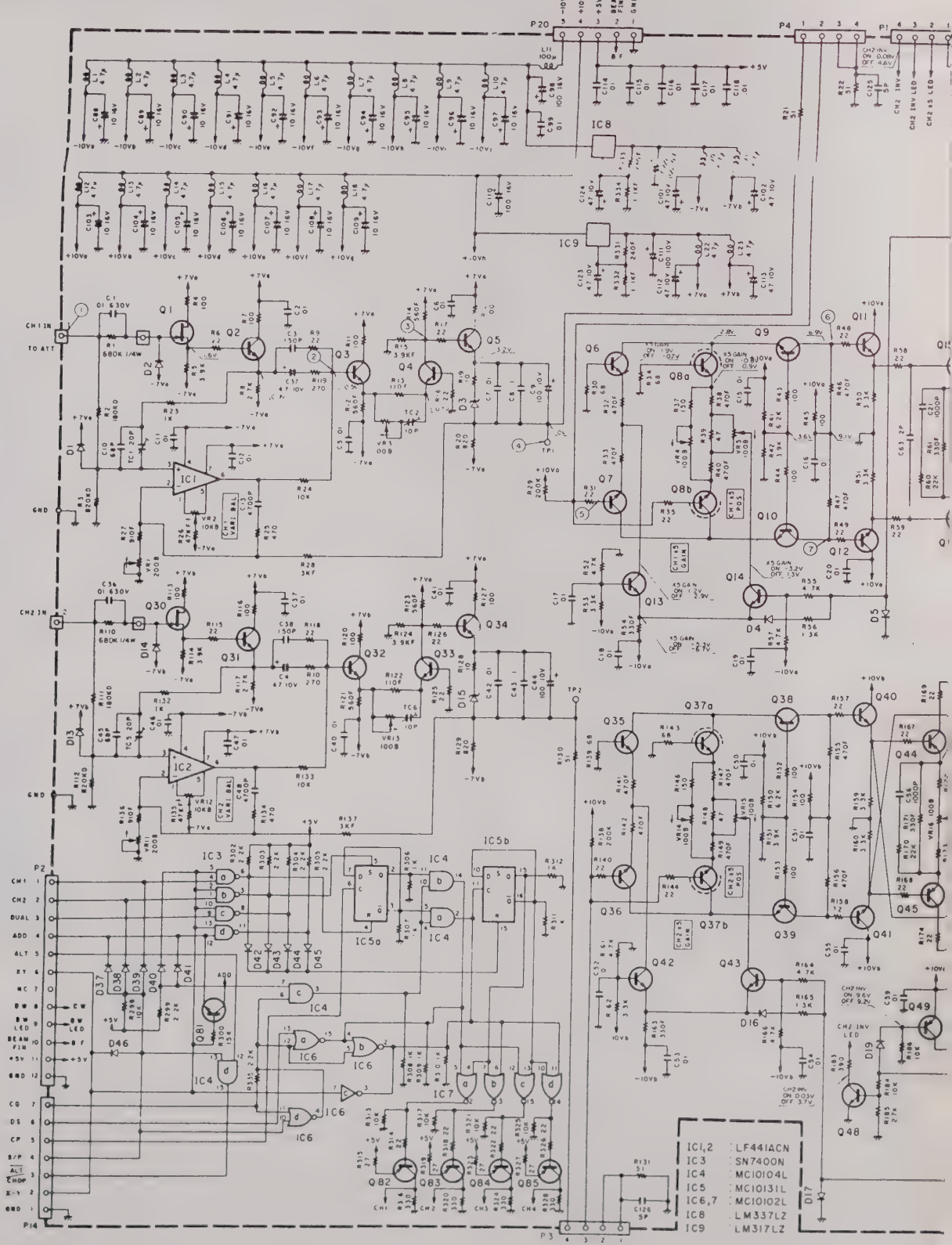
R1	10 Ω, 3 W, Wire Wound	004-215-9-001
R2	2 Ω, 3 W, Wire Wound	004-215-9-002
R4	220 kΩ, 1 W, Metal Oxide	004-215-9-003
R7	33 Ω, 1 W, Metal Oxide	004-215-9-004
R12	2.2 kΩ ±1%, 1/4 W, Metal Film	013-013-9-009
VR1	10 kΩ Trimmer Pot	008-502-9-001

CAPACITORS

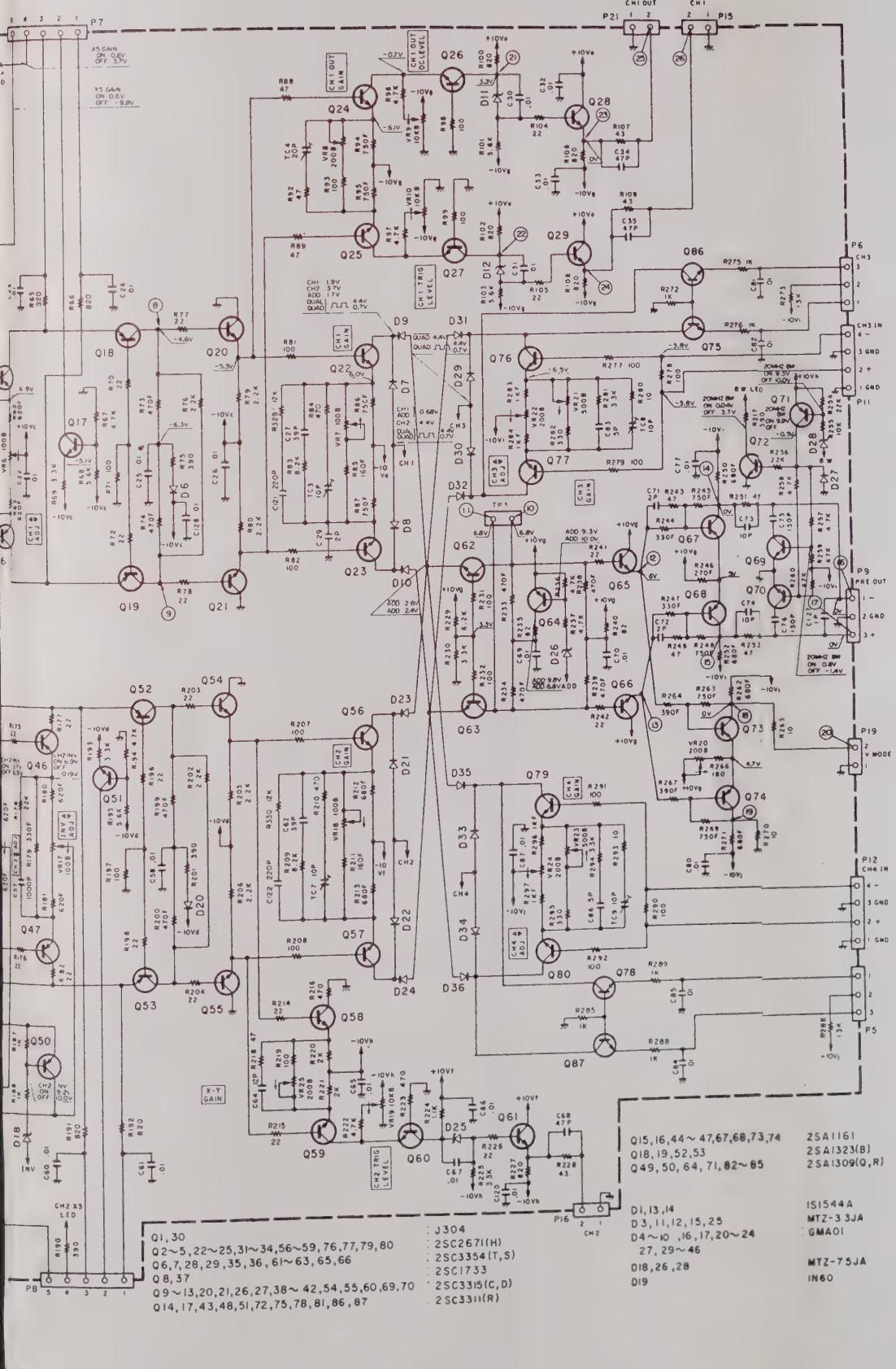
C1	0.22 µF, 400 V, Polyester	033-082-9-003
C2-5	2200 pF, 250 V, Ceramic	033-082-9-001
C6	100 µF, 400 V, Electrolytic	033-083-9-001
C7	4.7 µF, 50 V, Electrolytic	033-083-9-002
C8	10 µF, 50 V, Electrolytic	033-083-9-003
C9	47 µF, 25 V, Electrolytic	033-083-9-004
C10	0.01 µF, 50 V, Ceramic	020-296-9-001
C11	0.001 µF, 1 kV, Ceramic	033-082-9-002
C12	470 µF, 16 V, Electrolytic	033-083-9-005
C13	1000 µF, 10 V, Electrolytic	033-083-9-006
C14	470 µF, 16 V, Electrolytic	033-083-9-005
C15	220 µF, 35 V, Electrolytic	033-083-9-007
C16	100 µF, 63 V, Electrolytic	033-083-9-008
C17	22 µF, 160 V, Electrolytic	033-083-9-009
C18	220 µF, 16 V, Electrolytic	033-083-9-010

SCHEMATIC SYMBOL	DESCRIPTION	B & K-PRECISION PART NO.
C19	220 µF, 35 V, Electrolytic	033-083-9-007
C20	22 µF, 50 V, Electrolytic	033-083-9-011
C21	10 µF, 100 V, Electrolytic	033-083-9-012
C22	22 µF, 160 V, Electrolytic	033-083-9-009
C23	0.01 µF, 630 V, Ceramic	033-082-9-004
C24, 25	0.001 µF, 1 kV, Ceramic	033-082-9-002
C26	22 µF, 16 V, Electrolytic	033-083-9-013
	INDUCTORS	
L1	Line Filter	064-029-9-001
L2	Pulse Transformer	064-029-9-002
L3	20 µH Coil	041-153-9-001
L4	2.3 µH Coil	041-153-9-002
L5	20 µH Coil	041-153-9-001
L6-8	4.7 µH Ferri-Inductor	041-153-9-003
	DIODES	
D1	DBA20G	157-033-9-001
D2	DFA01	151-122-9-001
D3	DTA-10ER, Triac	181-014-9-001
D4	DS442X	151-097-9-001
D5, 6	GFD10E	151-122-9-002
D7	GFD10G	151-122-9-003
D8	HZ3.6CP, Zener Diode	152-139-9-001
D9	GZA6.2Z, Zener Diode	152-139-9-002
	TRANSISTORS	
Q1	2SC536KNP(F), NPN Transistor	176-114-9-001
	INTEGRATED CIRCUITS	
IC1	STK7308	307-368-9-001
	Insulator for IC1	342-122-9-001
IC2	STK732	307-369-9-001
	Insulator for IC2	342-122-9-002

VERTICAL PREAMP UNIT (X73-1500-00)

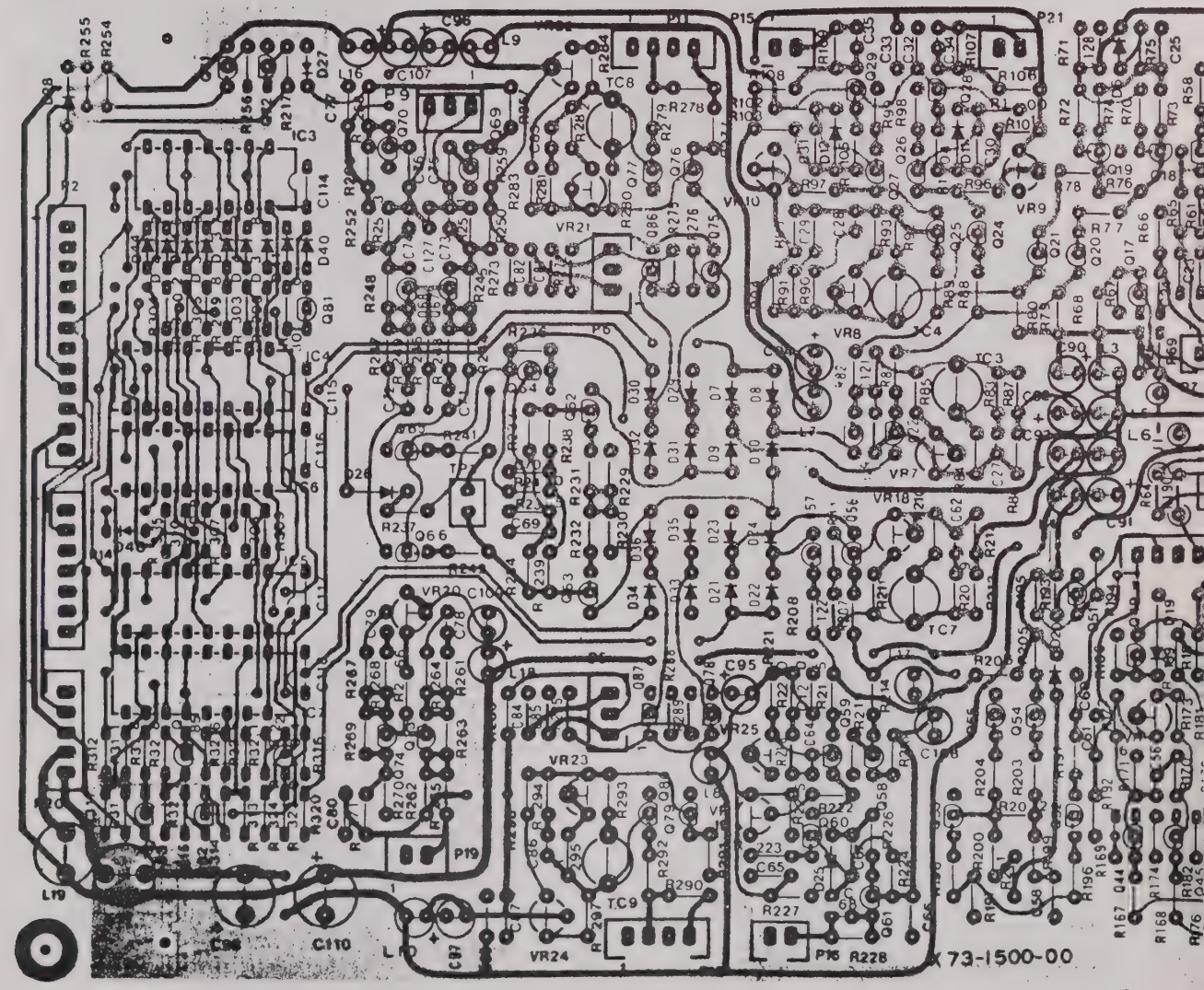


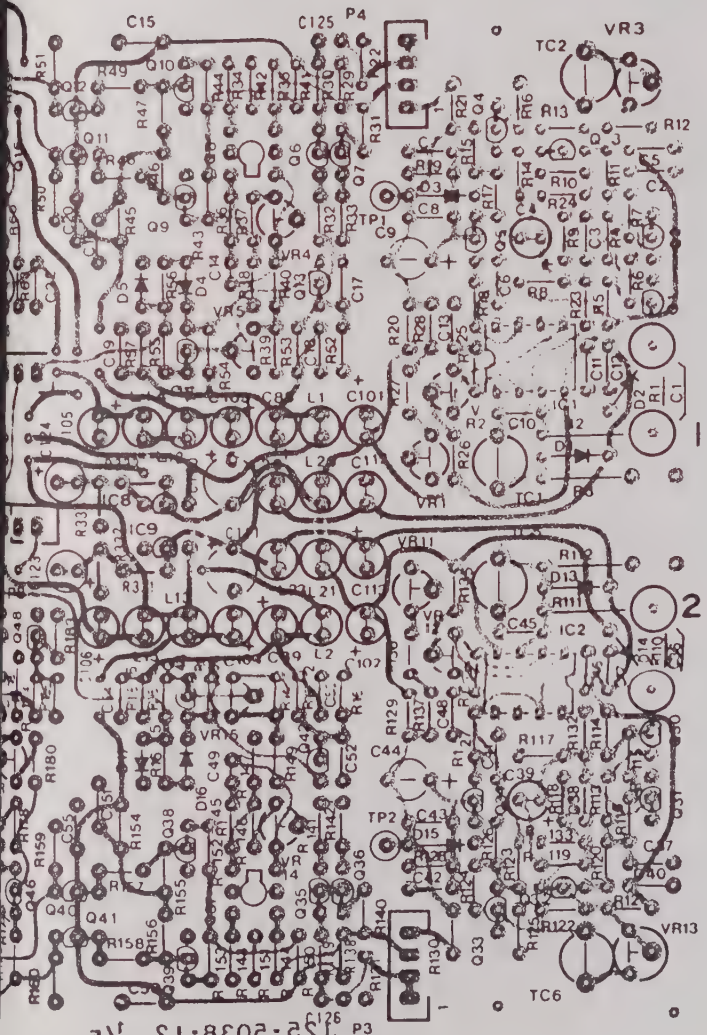
DIAGRAM


P7
CH1 OUT
P21
CH1
P15
X5 GAIN
ON 0.6V
OFF 3.7V
X5 GAIN
ON 0.6V
OFF - 9.8V
CH1 OUT GAIN
CH1 OUT DC LEVEL
CH1 TRIG LEVEL
CH1 GAIN
CH2 GAIN
CH3 GAIN
CH4 GAIN
CH3 ADJ
CH4 ADJ
P6
CH3
CH3 IN
P11
P9
PRE OUT
P19
V MODE
P12
CH4 IN
P5
P16
CH2
P8
CH2 X5
LED
X-Y GAIN
CH2 TRIG LEVEL
TP1
Q1, 30 : J304
Q2~5, 22~25, 31~34, 56~59, 76, 77, 79, 80 : 2SC2671(H)
Q6, 7, 28, 29, 35, 36, 61~63, 65, 66 : 2SC3354(T, S)
Q8, 37 : 2SC1733
Q9~13, 20, 21, 26, 27, 38~42, 54, 55, 60, 69, 70 : 2SC3315(C, D)
Q14, 17, 43, 48, 51, 72, 75, 78, 81, 86, 87 : 2SC3311(R)
Q15, 16, 44~47, 67, 68, 73, 74 : 2SA1161
Q18, 19, 52, 53 : 2SA1323(B)
Q49, 50, 64, 71, 82~85 : 2SA1309(Q, R)
D1, 13, 14 : IS1544A
D3, 11, 12, 15, 25 : MTZ-3.3JA
D4~10, 16, 17, 20~24, 27, 29~46 : GMA01
D18, 26, 28 : MTZ-7.5JA
D19 : IN60

ERTICAL PREAMP UNIT (X73-1500-00)

A | B | C




C15
C125
P4
TC2
VR3
R13
R12
R10
R24
C2
C8
C9
TP1
VR4
VR5
C14
C17
R20
C13
C10
IC1
D2
R1
C1
C101
L1
L2
C111
VR1
R26
R2
IC8
IC9
C117
VR11
R111
D13
C45
IC2
C48
R129
R117
C44
C39
TP2
C43
D15
R119
C47
R122
VR13
TC6
P3
C126
Q10
Q11
Q9
Q6
Q7
Q3
Q4
Q12
Q13
Q33
Q35
Q36
Q38
Q40
Q41
D4
D5
D6
VR6
VR7
R180
R154
R155
R156
R158
R159
R140
R139
C49
C52
C106
C107
C121
C122
C123
C124
C127
C128
C129
C130
C131
C132
C133
C134
C135
C136
C137
C138
C139
C140
C141
C142
C143
C144
C145
C146
C147
C148
C149
C150
C151
C152
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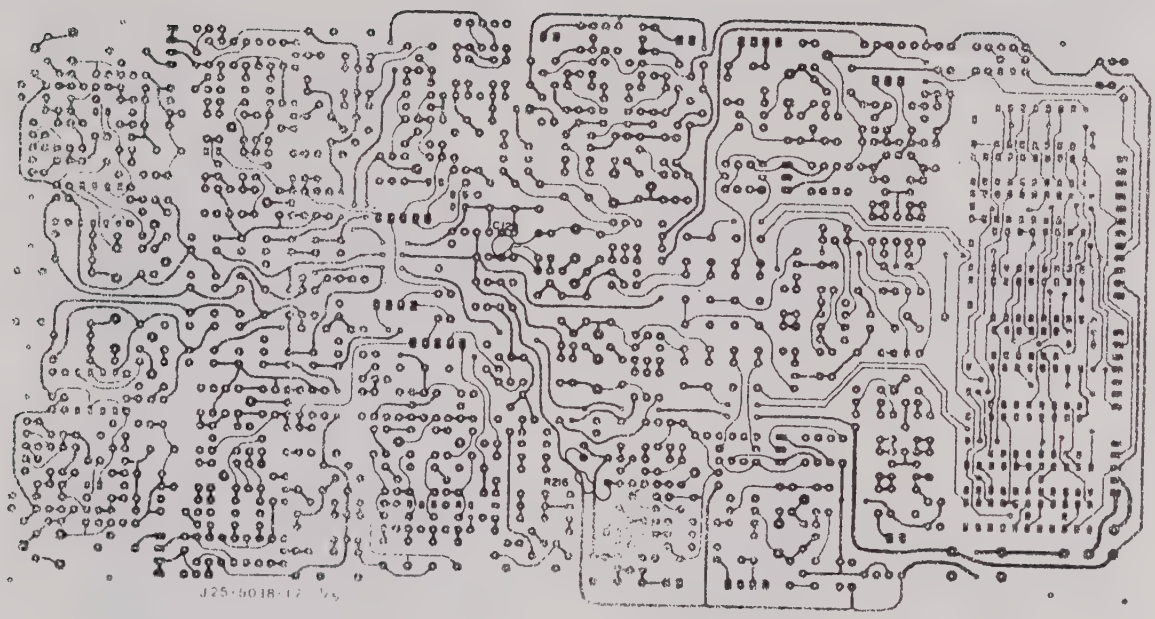
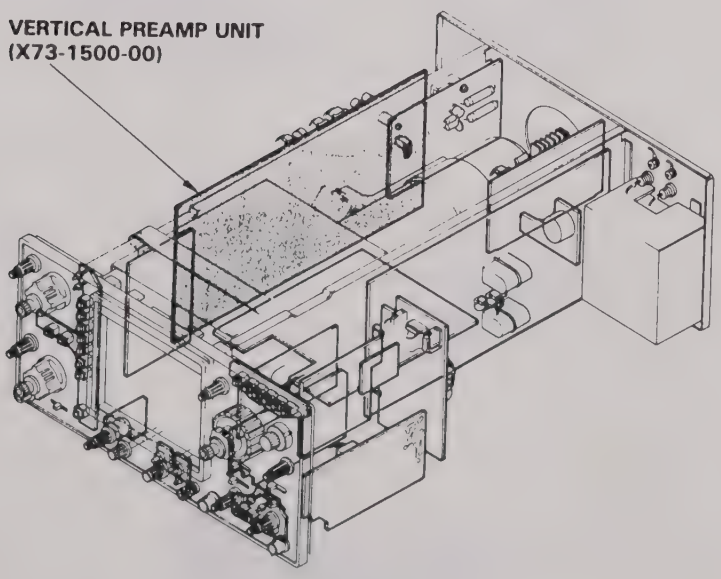
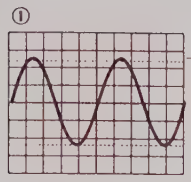
C161
C162
C163
C164
C165
C166

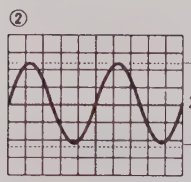


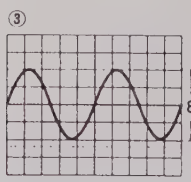
(FOIL SIDE VIEW)

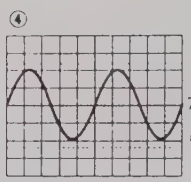


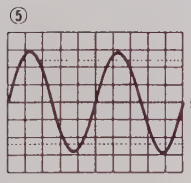
WAVEFORMS

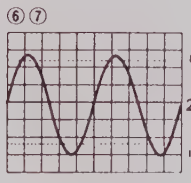

①
25 mVp-p

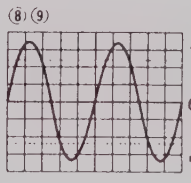

②
23 mVp-p

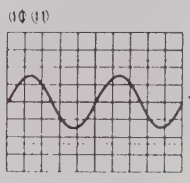

③
80 mVp-p

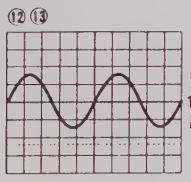

④
78 mVp-p

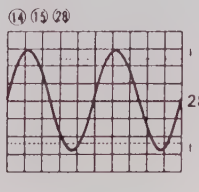

⑤
58 mVp-p

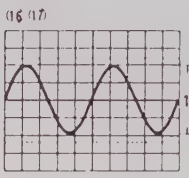

⑥⑦
28 mVp-p

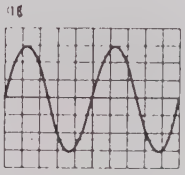

⑧⑨
64 mVp-p

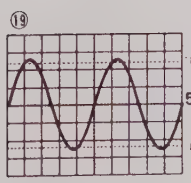

⑩⑪
160 m Vp-p

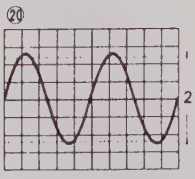

⑫⑬
150 mVp-p

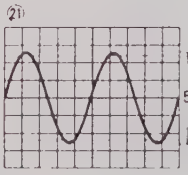

⑭⑮⑳
280 mVp-p

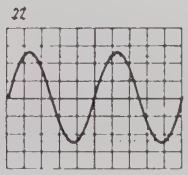

⑯⑰
190 mVp-p

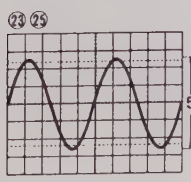

⑱
310 mVp-p


⑲
52 mVp-p


⑳
270 mVp-p


㉑
530 mVp-p


㉒
520 mVp-p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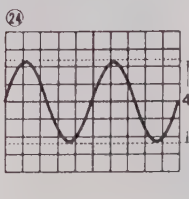
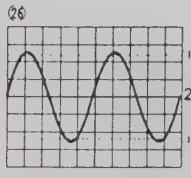
510 mVp-p


㉔
470 mVp-p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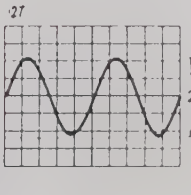
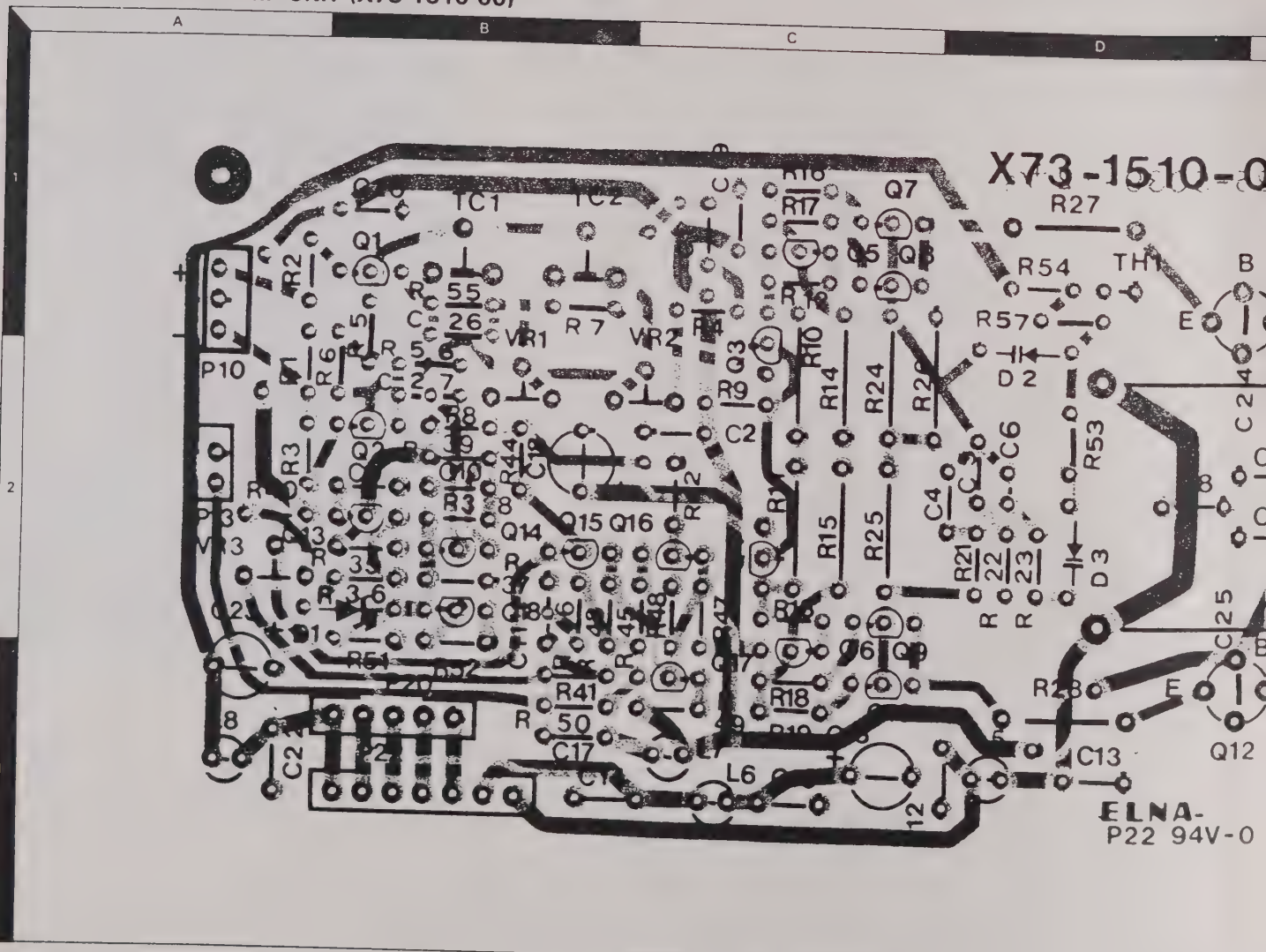
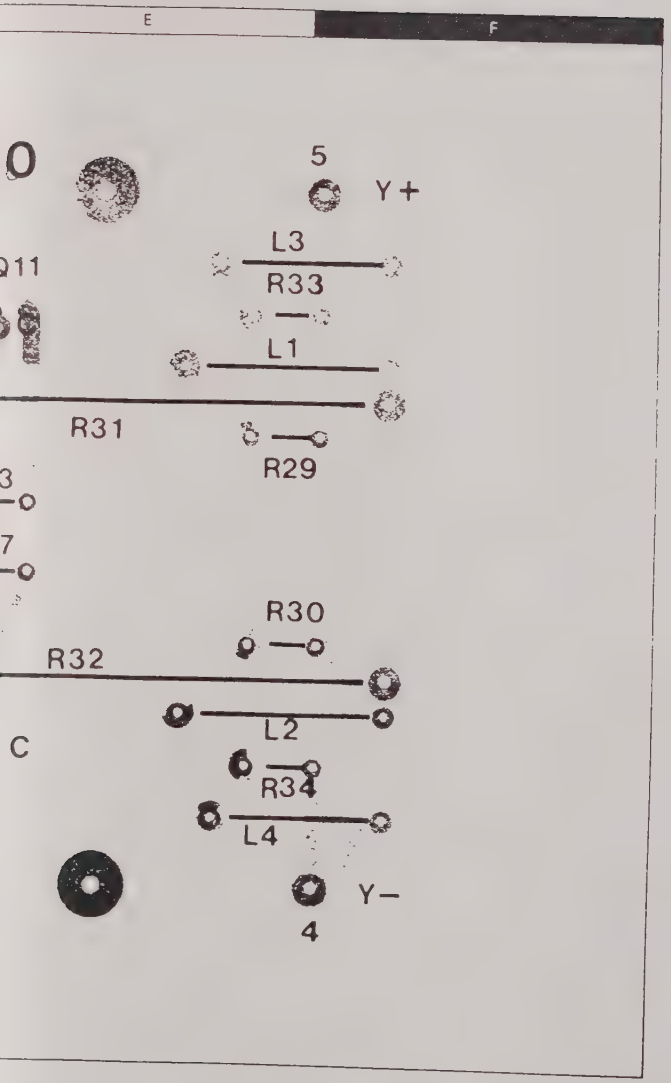
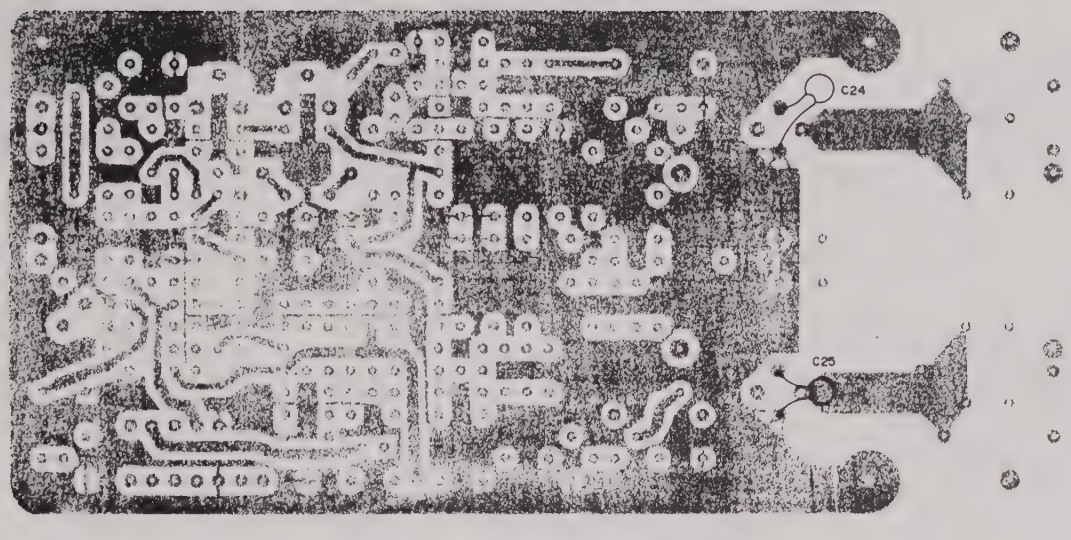
260 mVp-p


㉗
220 mVp-p

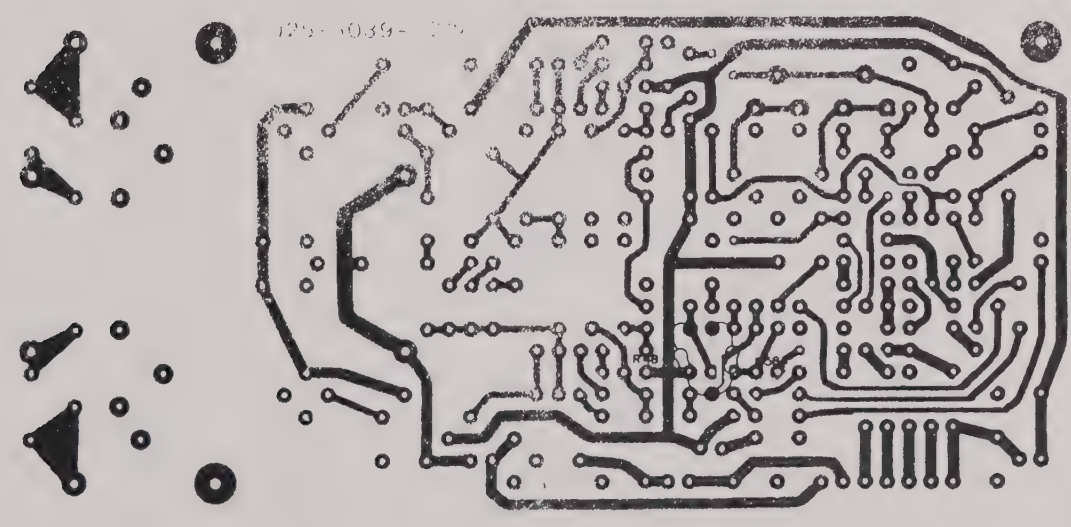
VERTICAL OUTPUT AMP UNIT (X73-1510-00)




E
F
0
5
Y+
L3
R33
L1
Q11
R31
R29
3
7
R30
R32
L2
C
R34
L4
Y−
4

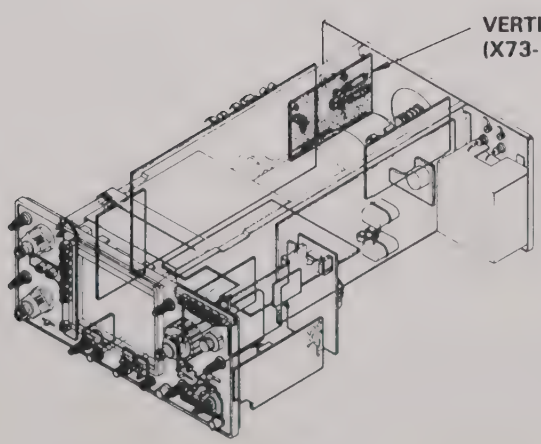


(COMPONENT SIDE VIEW)



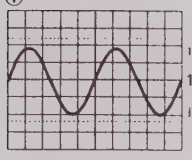
(FOIL SIDE VIEW)

VERTICAL OUTPUT AMP UNIT
(X73-1510-00)

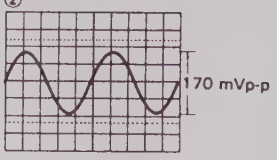


WAVEFORMS

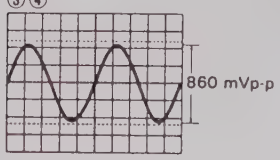
①



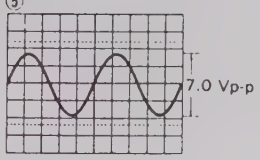
②



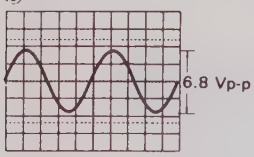
③④



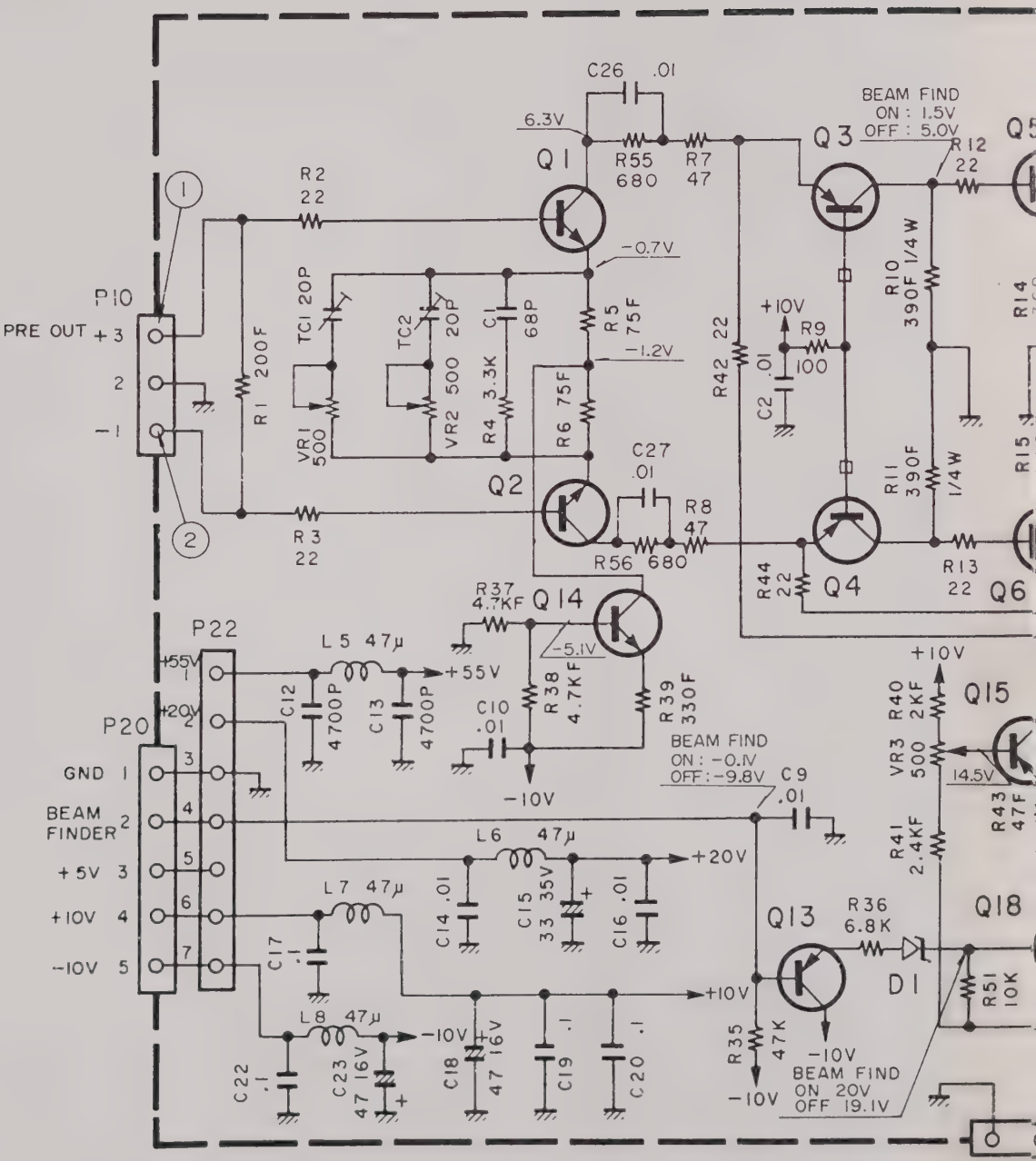
⑤



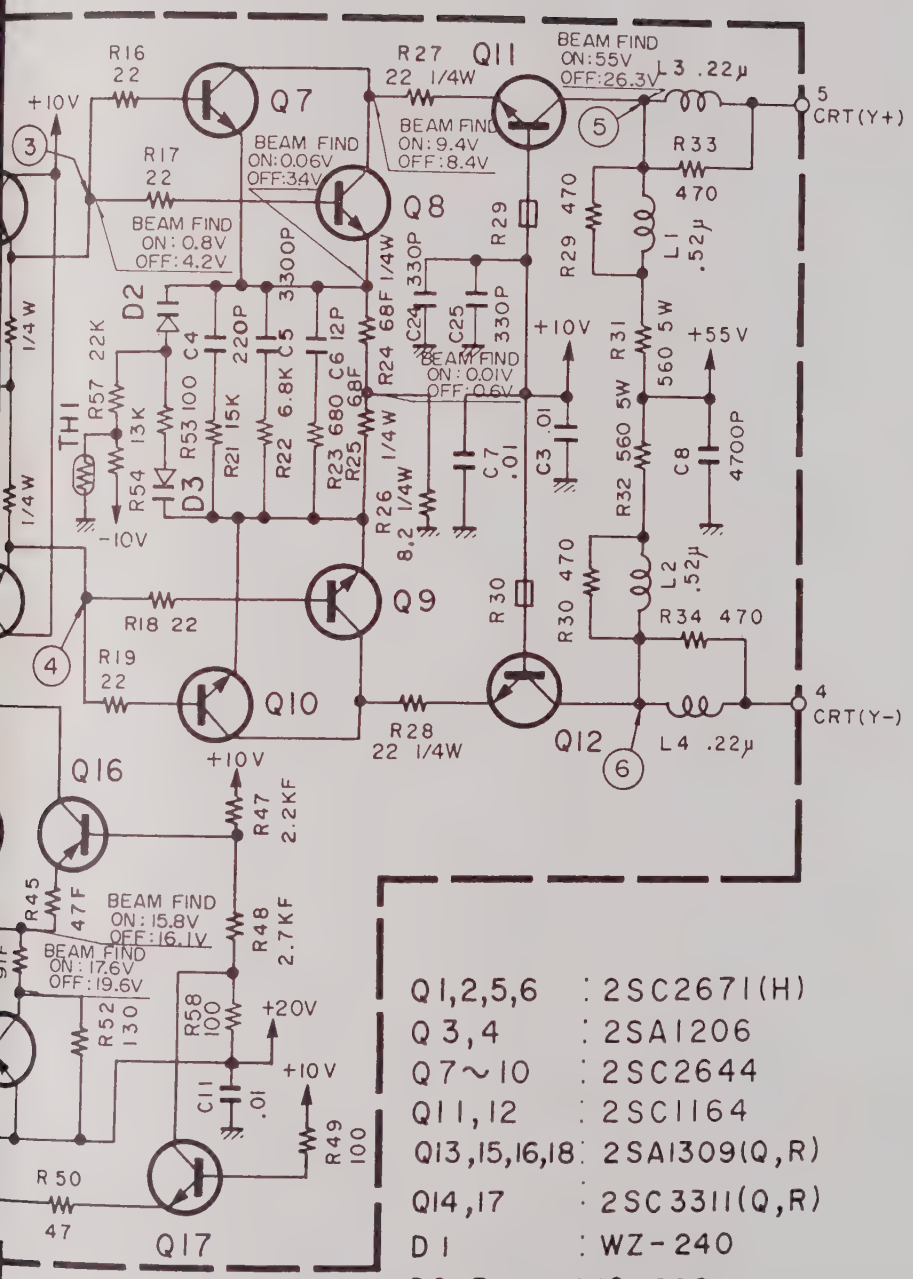
⑥



VERTICAL OUTPUT AMP UNIT (X73-1510-00)

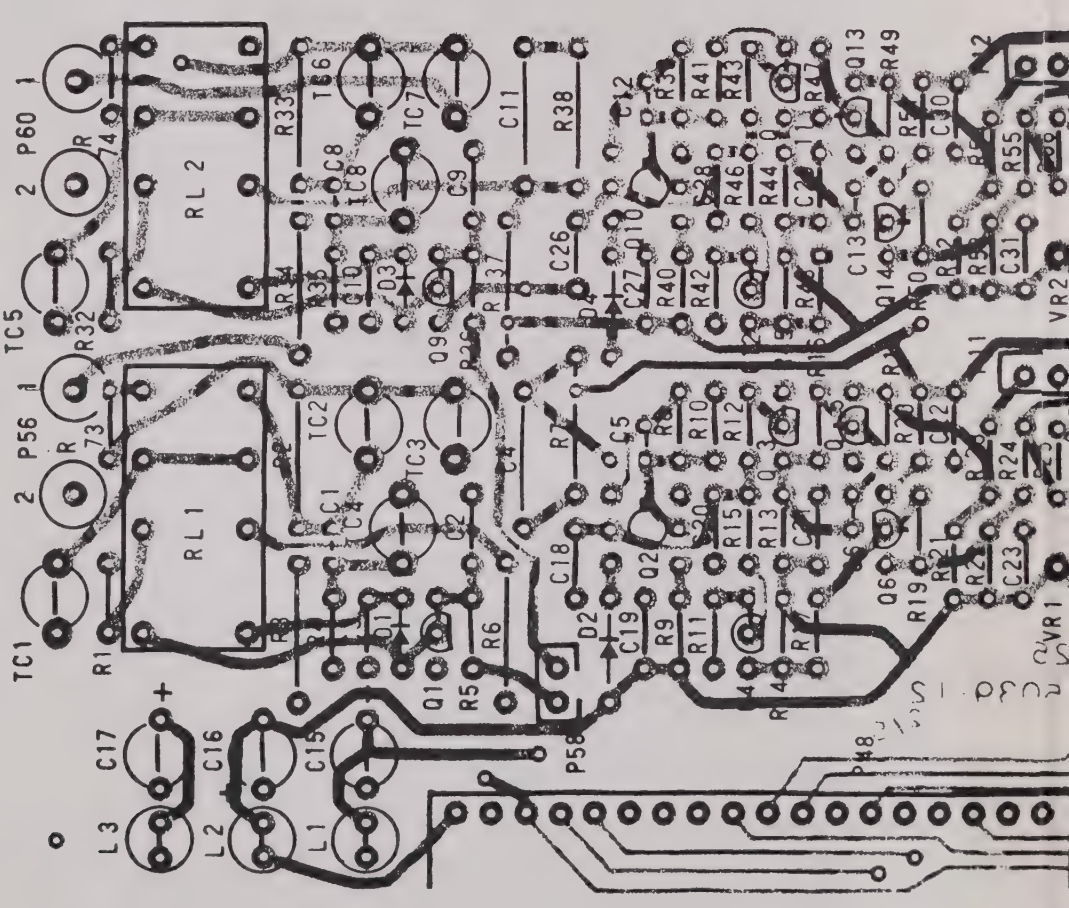


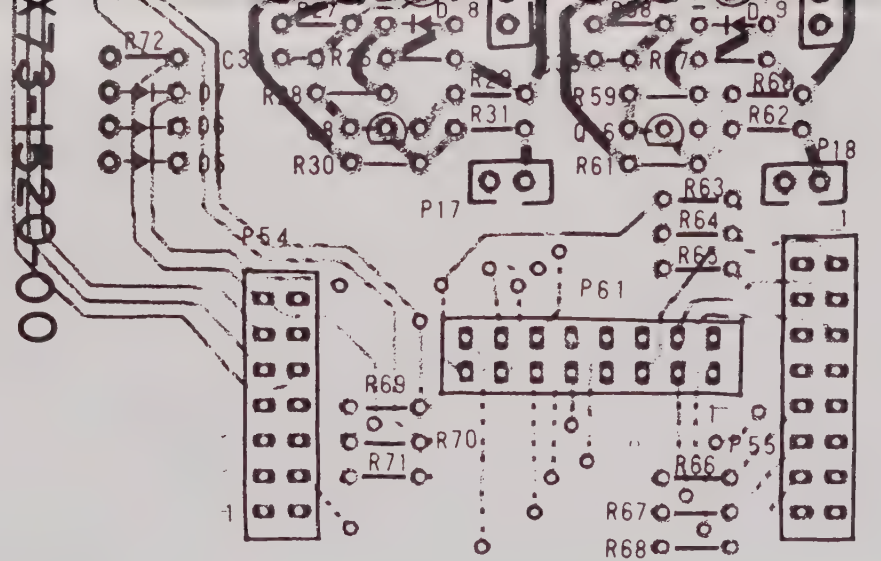
IAGRAM

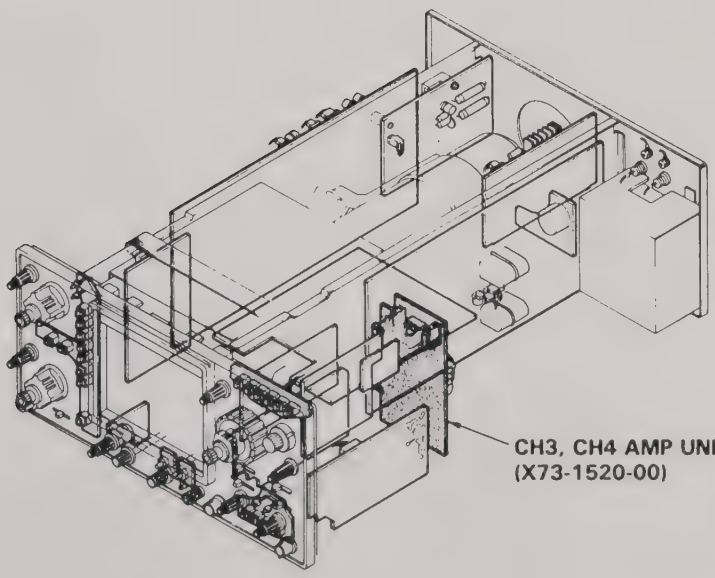


Q1,2,5,6	: 2SC2671(H)
Q3,4	: 2SA1206
Q7~10	: 2SC2644
Q11,12	: 2SC1164
Q13,15,16,18	: 2SA1309(Q,R)
Q14,17	: 2SC3311(Q,R)
D1	: WZ-240
D2,3	: 1S2686
TH1	: SDT-1000

H3, CH4 AMP UNIT (X73-1520-00)

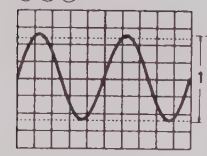



R72
C3
R30
R31
R59
R61
R62
P18
P17
R63
R64
R65
P54
P61
R69
R70
R71
P55
R66
R67
R68

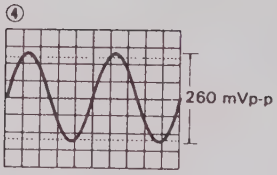

CH3, CH4 AMP UNIT
(X73-1520-00)

WAVEFORMS

①②③



④



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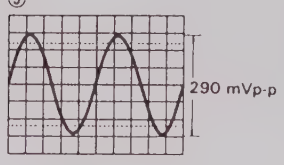
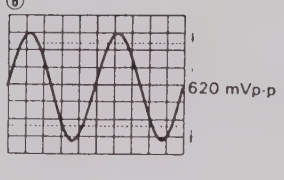
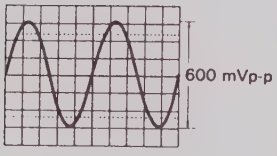


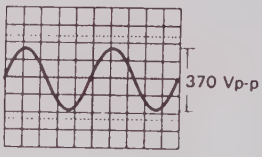
⑥



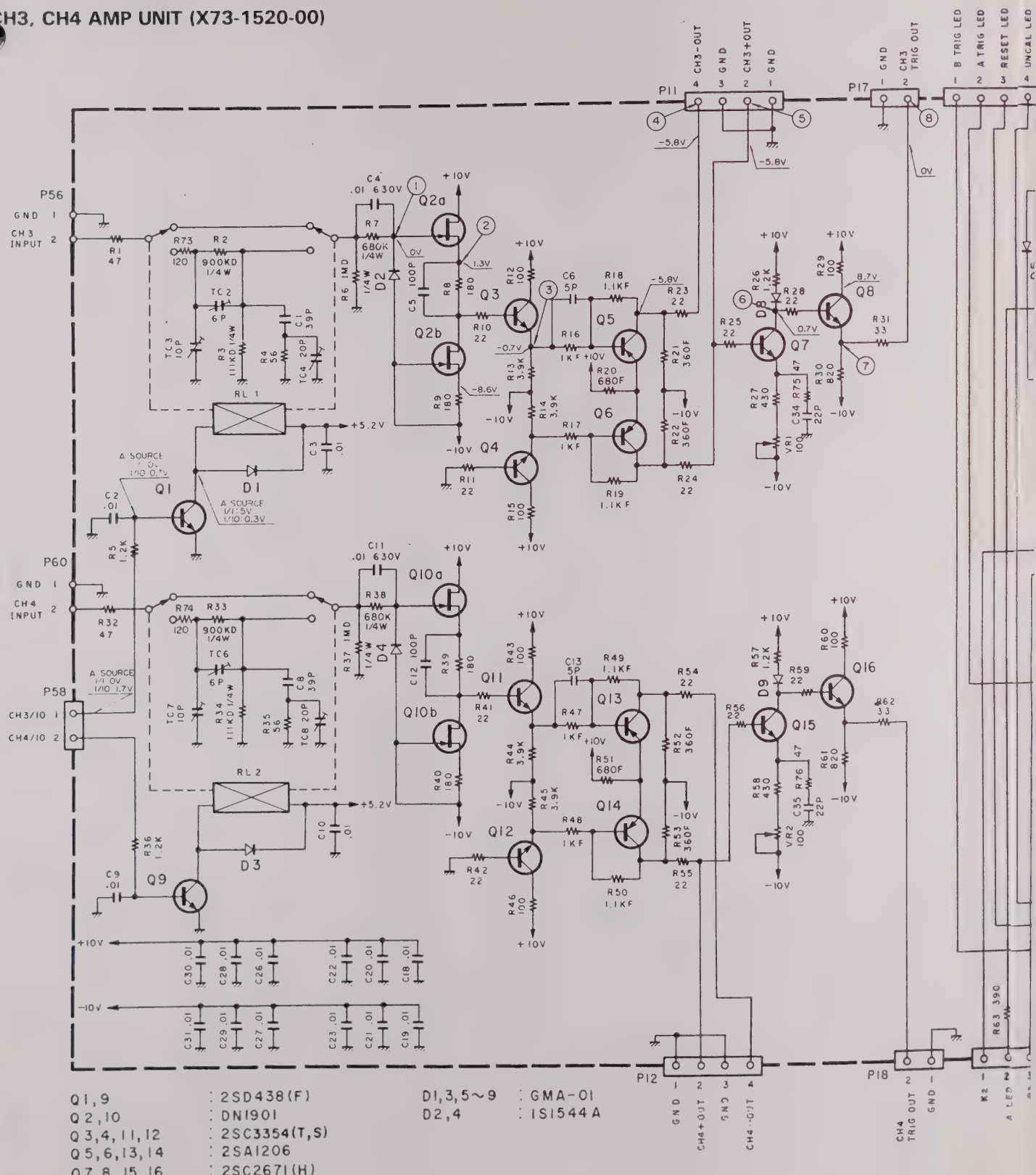
⑦



⑧



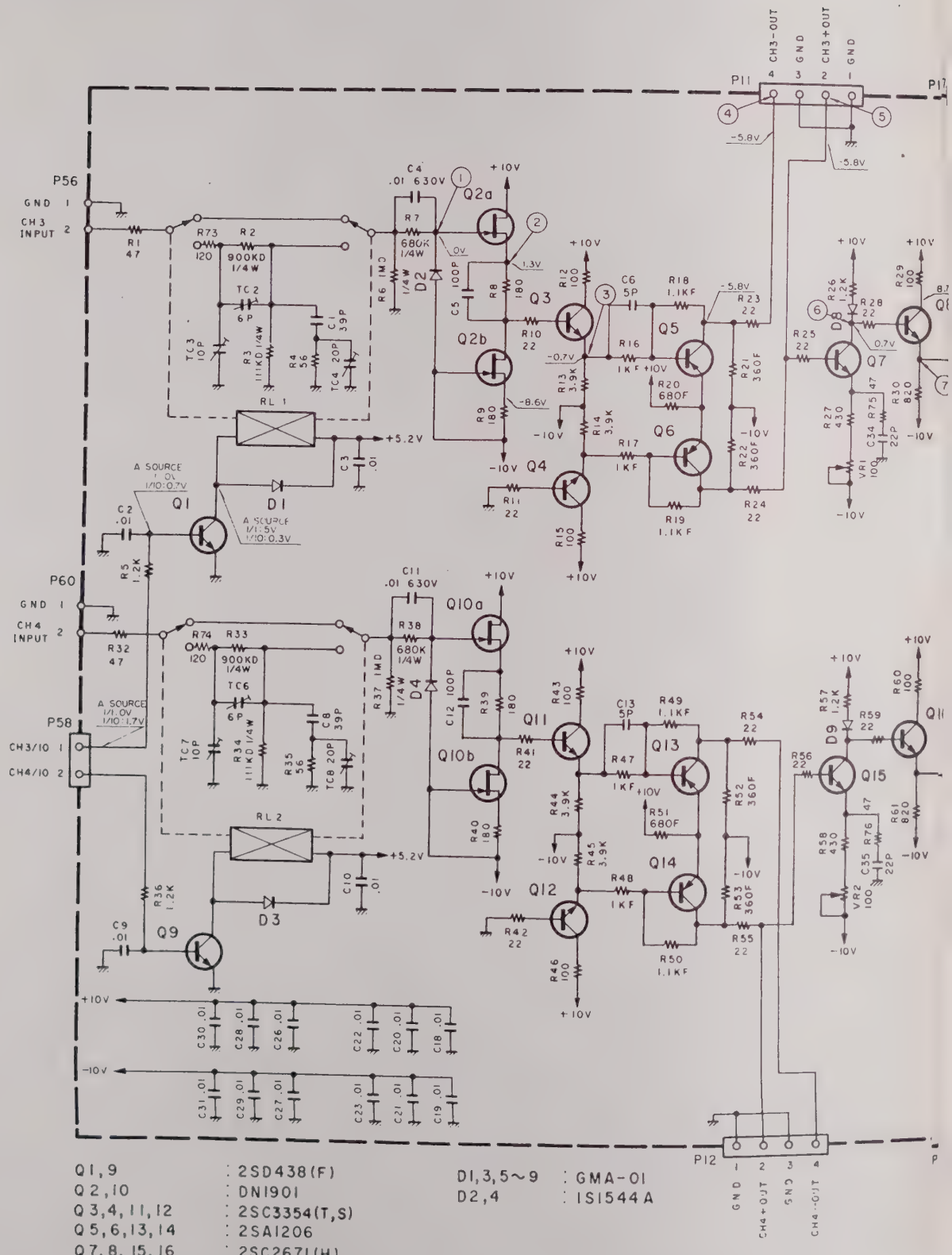
CH3, CH4 AMP UNIT (X73-1520-00)



Q1,9	: 2SD438(F)	D1,3,5~9	: GMA-01
Q2,10	: DN1901	D2,4	: 1S1544A
Q3,4,11,12	: 2SC3354(T,S)		
Q5,6,13,14	: 2SA1206		
Q7,8,15,16	: 2SC2671(H)		

P48
5 A/A-INT-B/B
6 +5V
7 +10V
8 NORM/AUTO
9 SINGLE
10 RESET
11 ALT
12 A-INT-B
13 A
14 DUAL
15 XY
16 GND
17 B
18 -10V
R72
2.2K
D6
D7
L3 22µ
+5.2V
C17
47 10V
C16
47 16V
L2
22µ
-10V
L1
22µ
+10V
C15
47 16V
P61
16 XY
15 A
14 ALT
13 A-INT-B
12 B
11 DUAL
10 AUTO
9 NOR
8 SINGLE
7 Ko
6 K1
5 K2
4 P3
3 P2
2 P1
1 Po
1 A TRIG LED
2 P2
3 AUTO LED
4 P1
5 NORM LED
6 Po
7 Ko
8 SINGL LED
9 RESET
10 GND
11 RESET LED
12 B TRIG LED
13 5V
14
P54
R71
390
R70
390
R69
390
R65
390
R66
390
R67
390
R68
390
P55
ALT LED
P2
A-INT-B LED
K1
UNCAL LED
P1
B LED
Po
DUAL LED
Ko
XY LED
5V

CH3, CH4 AMP UNIT (X73-1520-00)

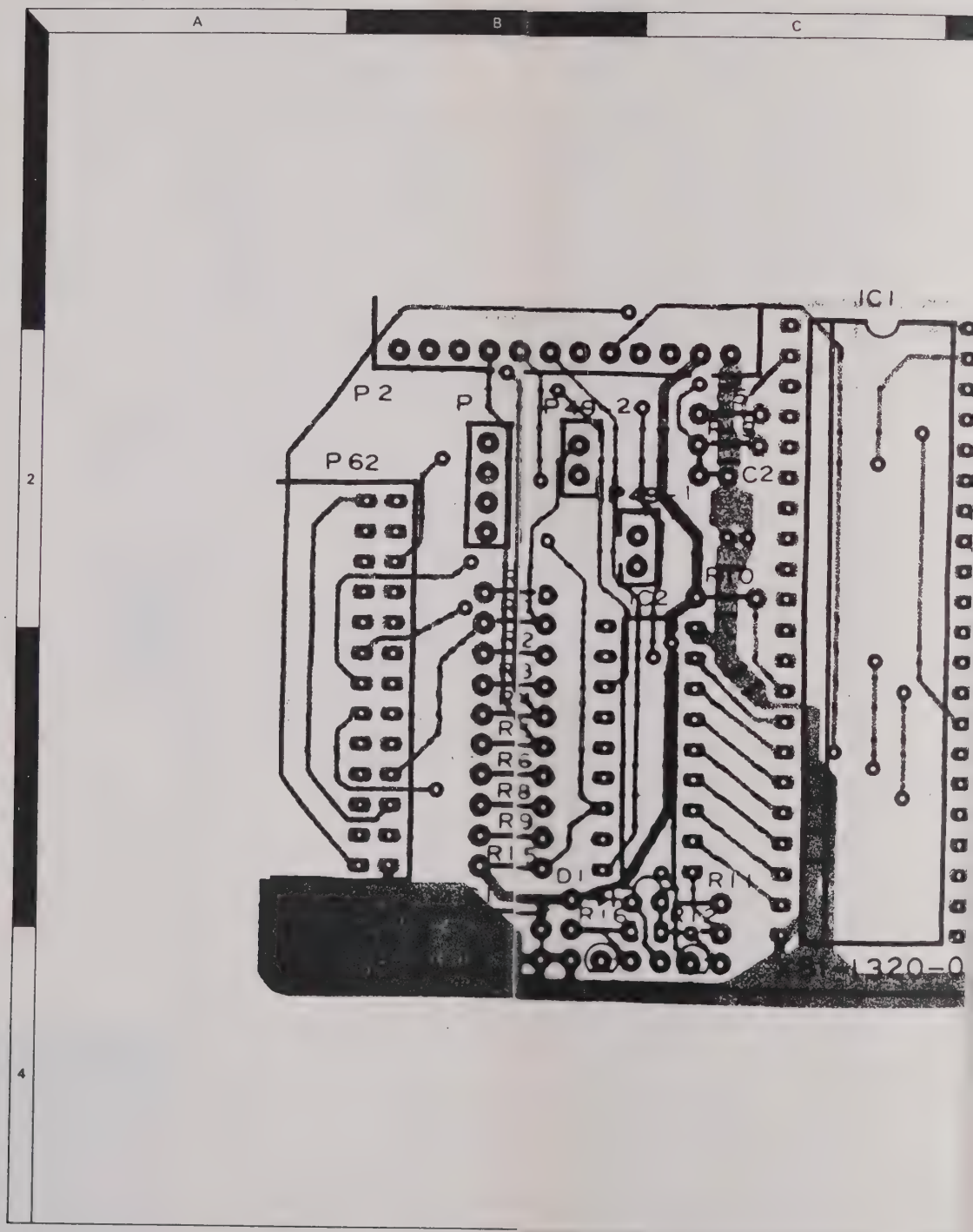


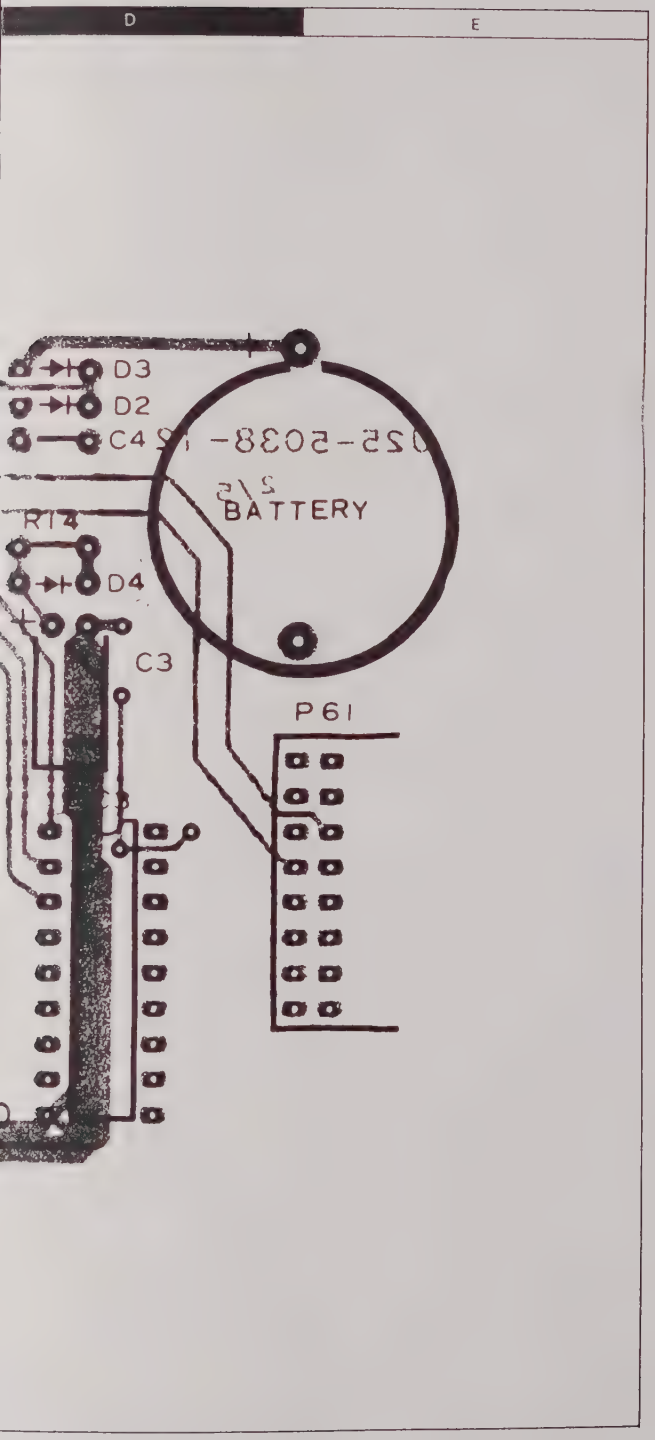
Q1,9	: 2SD438(F)	D1,3,5~9	: GMA-01
Q2,10	: DN1901	D2,4	: 1S1544A
Q3,4,11,12	: 2SC3354(T,S)		
Q5,6,13,14	: 2SA1206		
Q7,8,15,16	: 2SC2671(H)		

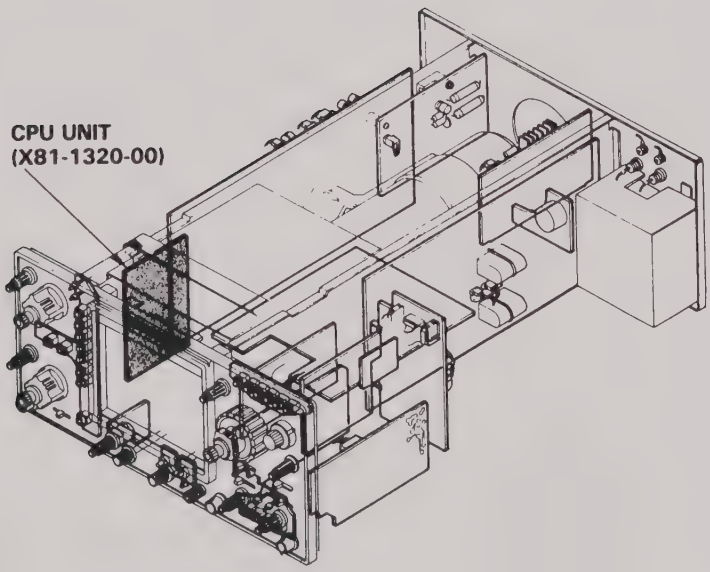
C DIAGRAM

P48
P61
P54
P55
R72 2.2K
D5
D6
D7
L3 22µ
L2 22µ
L1 22µ
C17 47 10V
C16 47 16V
C15 47 16V
+5.2V
-10V
+10V
R71 390
R70 390
R69 390
R63 390
R64 390
R65 390
R66 390
R67 390
R68 390
B TRIG LED
A TRIG LED
RESET LED
UNCAL LED
A/Ā-INT-B/B
+5V
+10V
NORM/AUTO
SINGLE
RESET
ALT
A-INT-B
A
DUAL
XY
GND
B
-10V
CH3 TRIG OUT
CH4 TRIG OUT
GND
0V
16 XY
15 A
14 ALT
13 A-INT-B
12 B
11 DUAL
10 AUTO
9 NOR
8 SINGLE
7 K0
6 K1
5 K2
4 P3
3 P2
2 P1
1 P0
1 A TRIG LED
2 P2
3 AUTO LED
4 P1
5 NORM LED
6 P0
7 K0
8 SINGL LED
9 RESET
10 GND
11 RESET LED
12 B TRIG LED
13 5V
14
K2
A LED
P3
ALT LED
P2
A-INT-B LED
K1
UNCAL LED
P1
B LED
P0
DUAL LED
K0
XY LED
5V
16

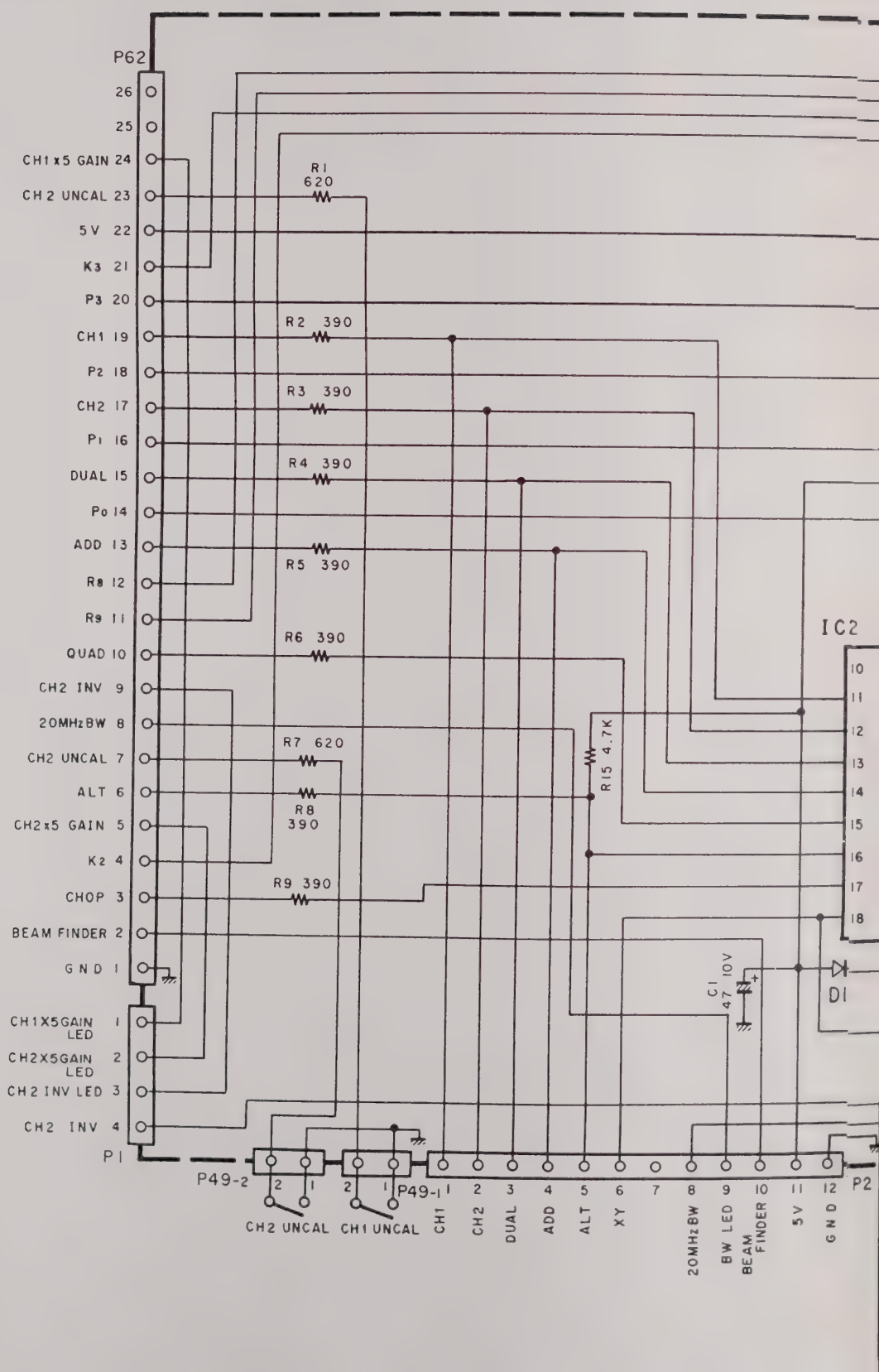
CPU UNIT (X81-1320-00)



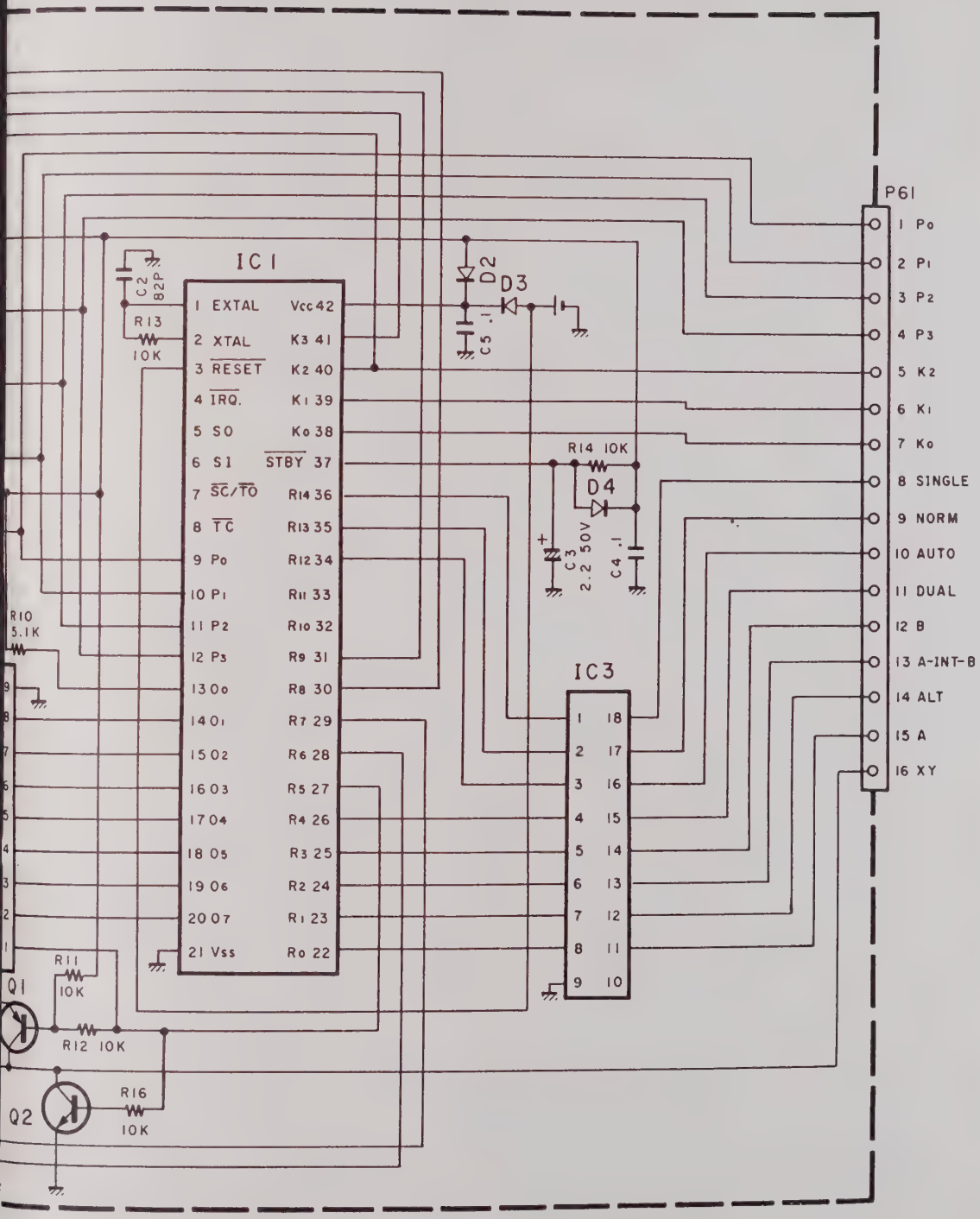

D
E
D3
D2
C4
BATTERY
R14
D4
C3
P61


CPU UNIT
(X81-1320-00)

CPU UNIT (X81-1320-00)



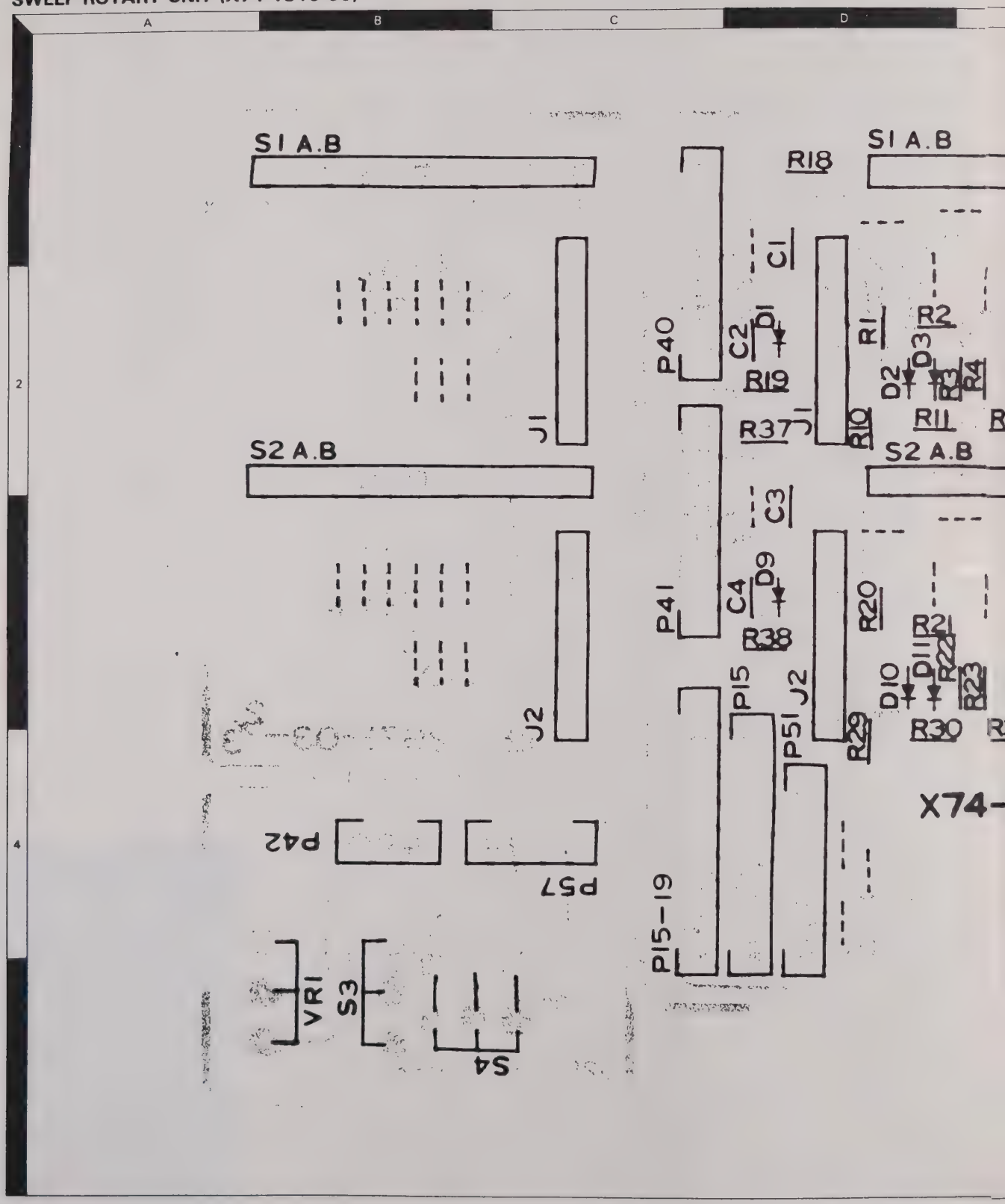
AGRAM



IC1 : MTM-5010
IC2,3 : AN90B20

Q1 : 2SA1309(Q,R)
Q2 : 2SC3311(R)
D1,2,3,4 : GMA-01

SWEEP ROTARY UNIT (X74-1310-00)



E F G

R17

D5 D6 D7

R5 R6 R7 R8 R16

R13 R14 R15

R36

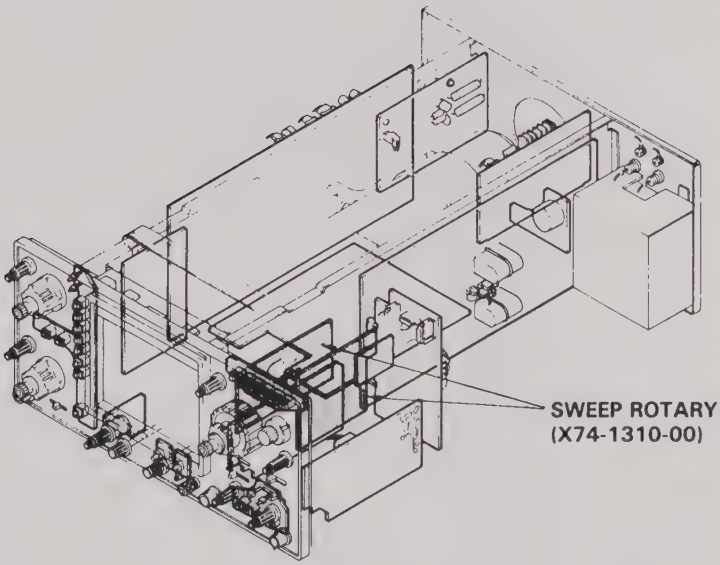
D13 D14 D15 D16

R24 R25 R26 R27 R28 R35

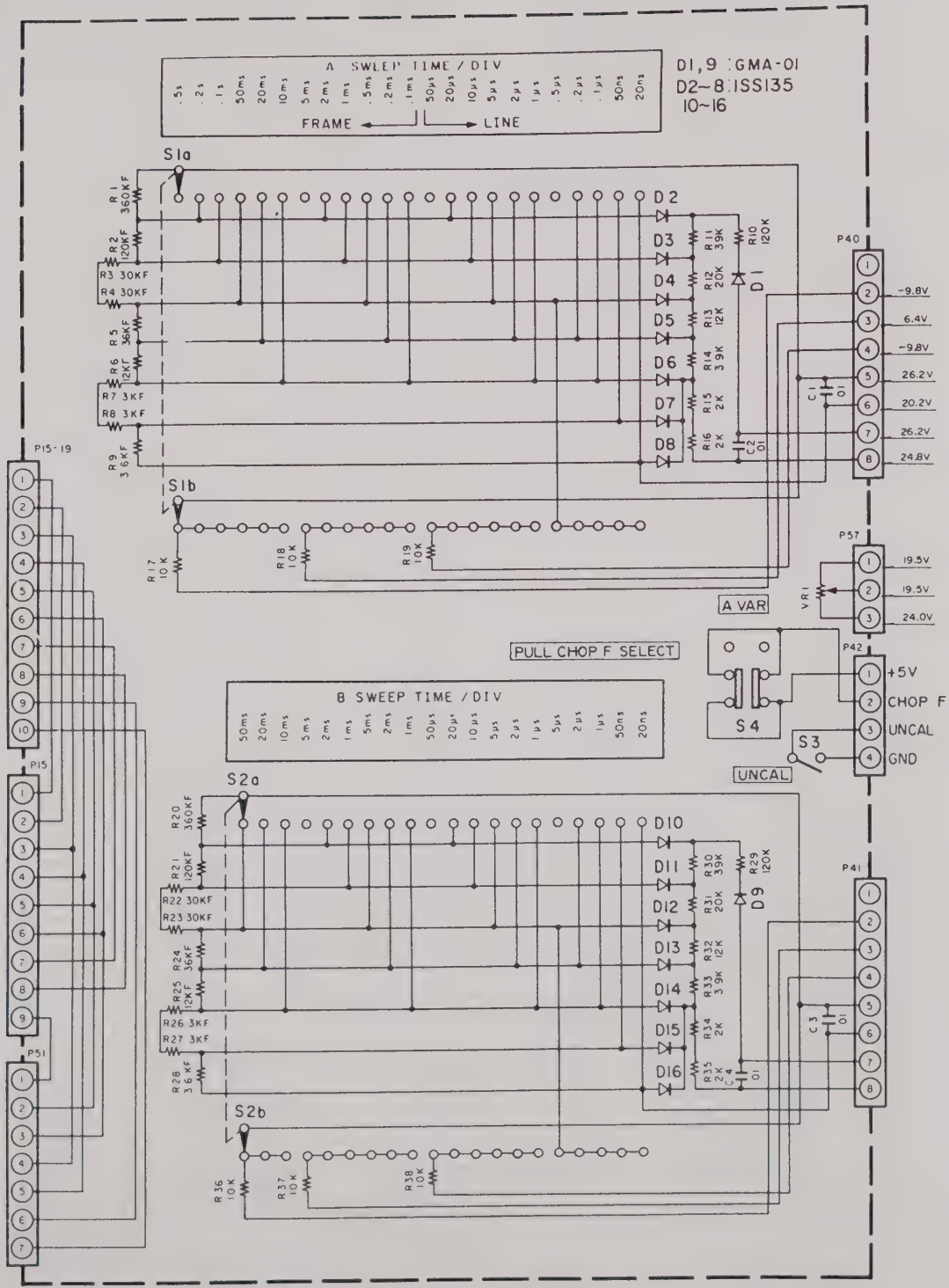
R32 R33 R34

310-00

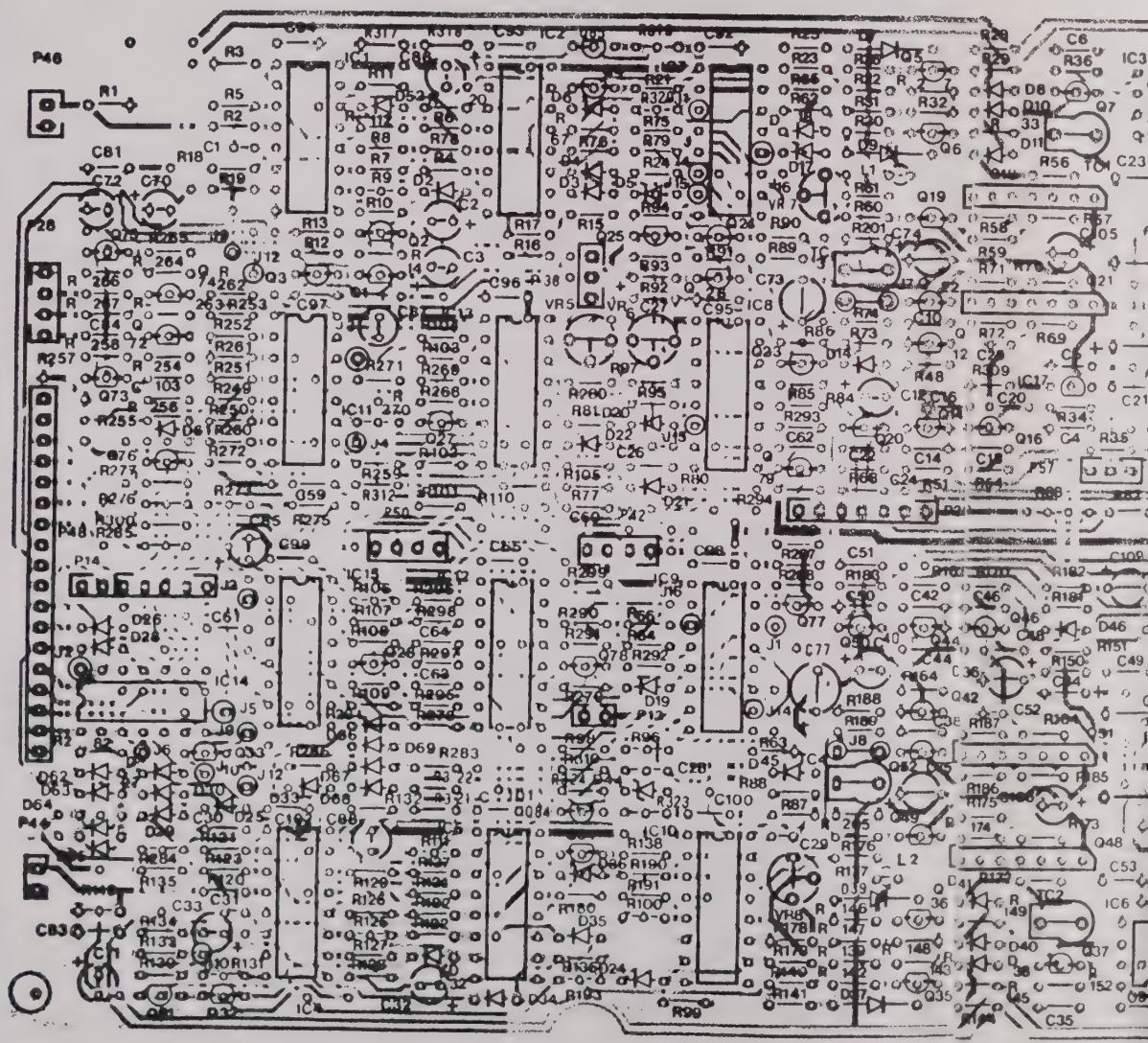
X74-1310-00

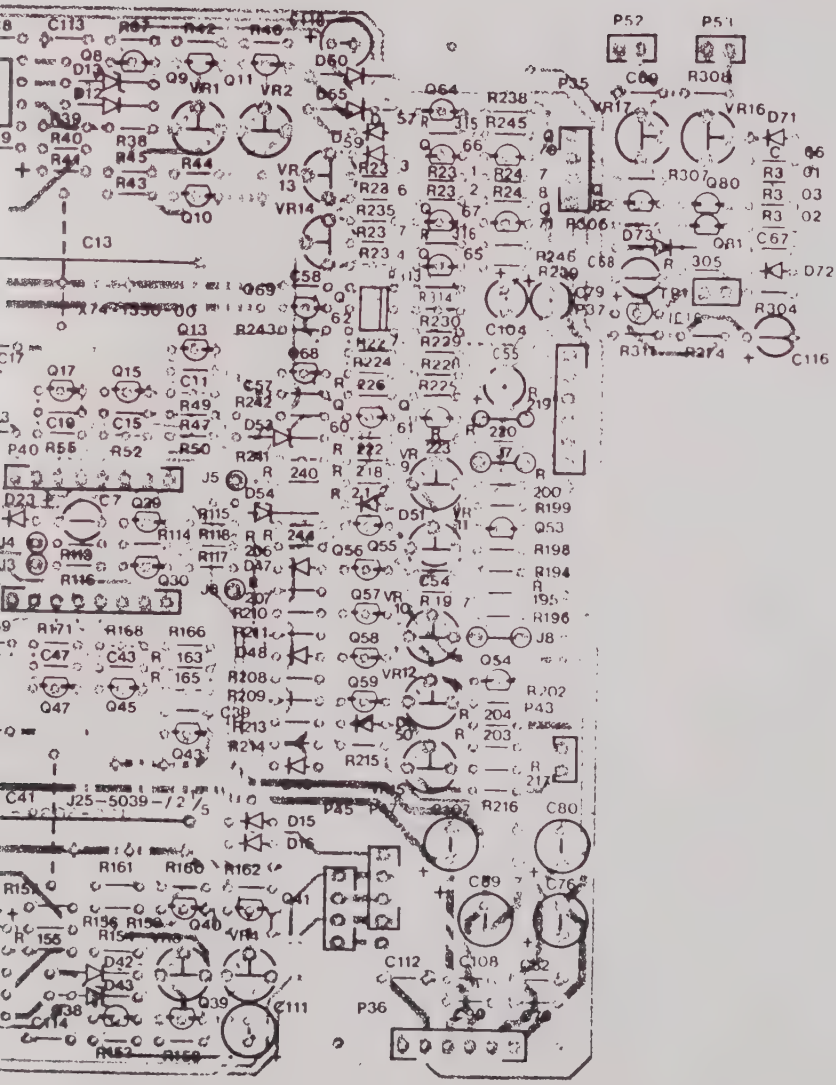

SWEEP ROTARY UNIT
(X74-1310-00)

SWEEP ROTARY UNIT (X74-1310-00)



TRIG SWEEP UNIT (X74-1350-00)




D
E
P52
P51
C113
R67
R42
R46
D60
D65
D59
Q64
R238
R245
P35
C69
R308
VR17
VR16
D71
Q8
D12
Q9
VR1
Q11
VR2
R40
R38
R45
R44
R43
Q10
VR
13
VR14
R235
R23 7
R23 4
R23 5
R23 6
R23 3
R23 2
R24 7
R24 8
R24 9
R24 6
R23 1
R24
Q66
Q67
Q65
R316
R314
R246
R239
C68
C79
P37
IC16
R307
Q80
R306
D73
Q81
R 305
C67
D72
R304
C116
R311
R274
C13
C58
Q69
R243
Q13
R224
R220
R225
R226
C55
C104
R230
R229
R219
R 220
J7
R 200
R199
Q53
R198
R194
R 195
R196
J8
Q54
R202
P43
R 204
R 203
R 217
R216
C80
C89
C76
C112
C108
C82
P36
C111
C57
R242
D52
R241
R 240
J5
D54
D51
Q56
Q55
C54
R 19
Q57
Q58
Q59
VR12
R215
P45
Q62
D15
D16
Q41
VR11
Q40
D42
D43
D39
C114
R152
R159
R161
R160
R162
R156
R155
R154
R153
R158
R157
C41
J25-5039-72/5
C47
C43
R 163
R 165
Q47
Q45
Q43
R171
R168
R166
C39
R208
R209
R213
R214
D48
D47
R210
R211
R207
R206
R 244
R 205
R115
R116
R117
R118
Q30
R114
C7
Q29
D23
J4
J3
R119
R116
C17
C10
C15
R47
R50
R52
R55
R40
Q17
Q15
C11
R49
R 222
R 218
R 221
VR 9
VR 11
R 223
R 219
R 220
R 200
R199
R198
R194
R 195
R196
J8
Q54
R202
P43
R 204
R 203
R 217
R216
C80
C89
C76
C112
C108
C82
P36
C111
C57
R242
D52
R241
R 240
J5
D54
D51
Q56
Q55
C54
R 19
Q57
Q58
Q59
VR12
R215
P45
Q62
D15
D16
Q41
VR11
Q40
D42
D43
D39
C114
R152
R159
R161
R160
R162
R156
R155
R154
R153
R158
R157
C41
J25-5039-72/5
C47
C43
R 163
R 165
Q47
Q45
Q43
R171
R168
R166
C39
R208
R209
R213
R214
D48
D47
R210
R211
R207
R206
R 244
R 205
R115
R116
R117
R118
Q30
R114
C7
Q29
D23
J4
J3
R119
R116
C17
C10
C15
R47
R50
R52
R55
R40
Q17
Q15
C11
R49
R 222
R 218
R 221
VR 9
VR 11
R 223
R 219
R 220
R 200
R199
R198
R194
R 195
R196
J8
Q54
R202
P43
R 204
R 203
R 217
R216
C80
C89
C76
C112
C108
C82
P36
C111
C57
R242
D52
R241
R 240
J5
D54
D51
Q56
Q55
C54
R 19
Q57
Q58
Q59
VR12
R215
P45
Q62
D15
D16
Q41
VR11
Q40
D42
D43
D39
C114
R152
R159
R161
R160
R162
R156
R155
R154
R153
R158
R157
C41
J25-5039-72/5
C47
C43
R 163
R 165
Q47
Q45
Q43
R171
R168
R166
C39
R208
R209
R213
R214
D48
D47
R210
R211
R207
R206
R 244
R 205
R115
R116
R117
R118
Q30
R114
C7
Q29
D23
J4
J3
R119
R116
C17
C10
C15
R47
R50
R52
R55
R40
Q17
Q15
C11
R49
R 222
R 218
R 221
VR 9
VR 11
R 223
R 219
R 220
R 200
R199
R198
R194
R 195
R196
J8
Q54
R202
P43
R 204
R 203
R 217
R216
C80
C89
C76
C112
C108
C82
P36
C111
C57
R242
D52
R241
R 240
J5
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Q55
C54
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Q57
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VR11
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C43
R 163
R 165
Q47
Q45
Q43
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R166
C39
R208
R209
R213
R214
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D47
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R211
R207
R206
R 244
R 205
R115
R116
R117
R118
Q30
R114
C7
Q29
D23
J4
J3
R119
R116
C17
C10
C15
R47
R50
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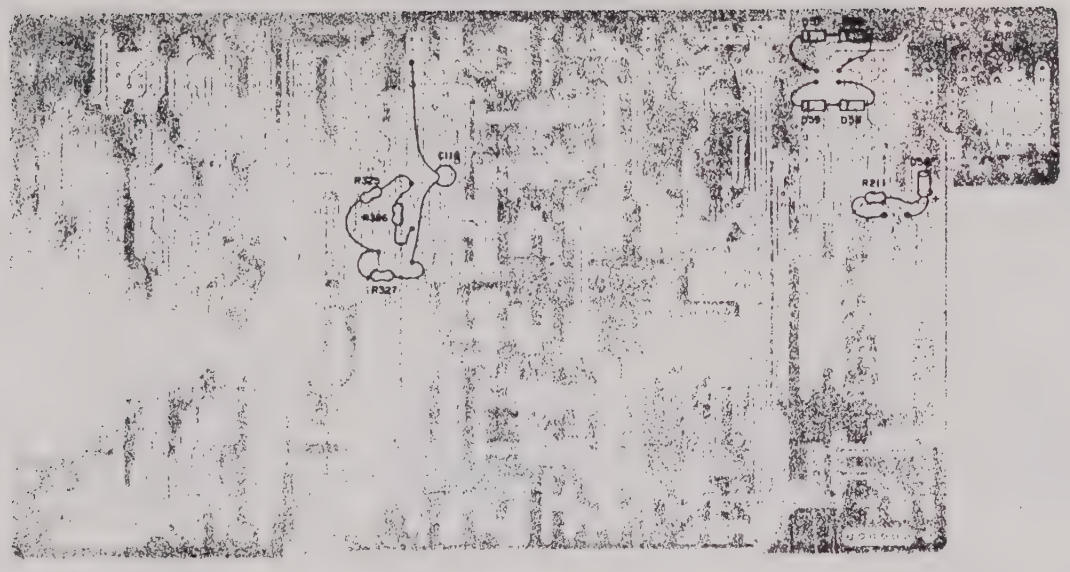
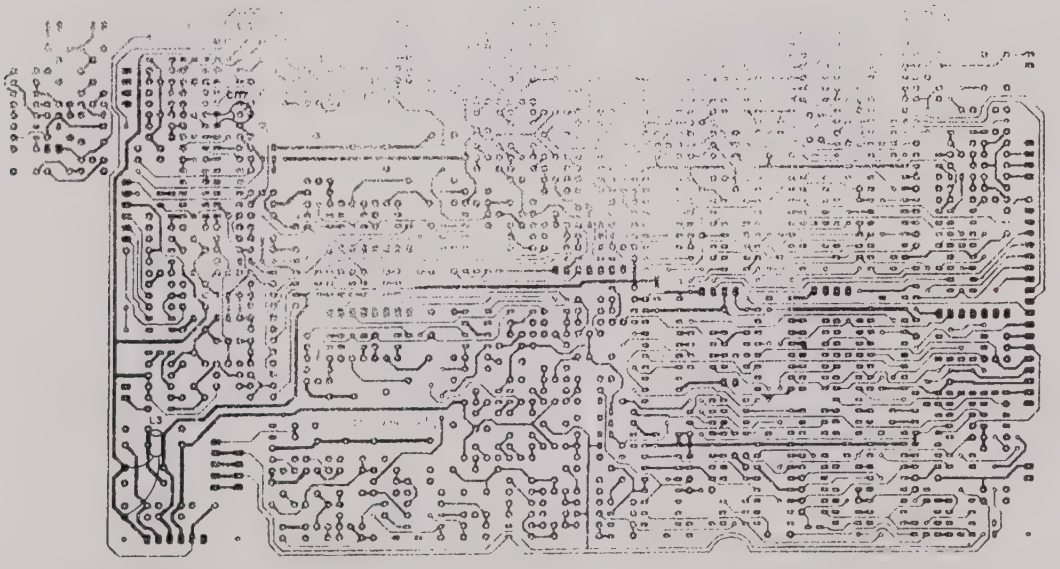
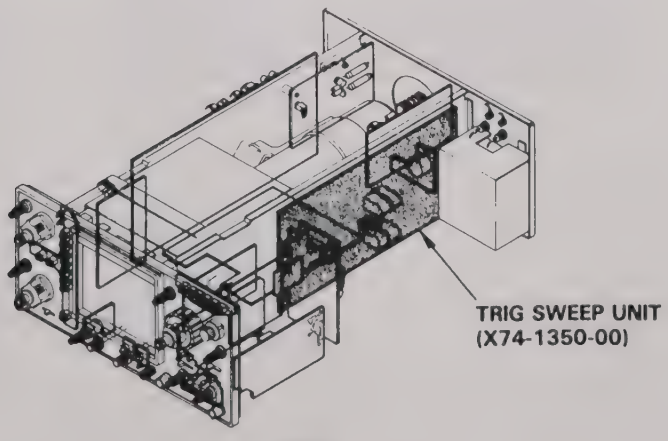
VR 11
R 223
R 219
R 220



(COMPONENT SIDE VIEW)

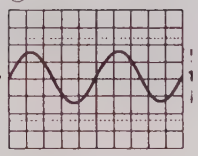


(FOIL SIDE VIEW)

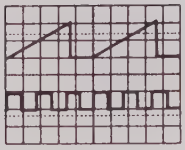


WAVEFORMS

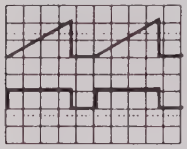
① 4.2 V, 1.5 Vp-p



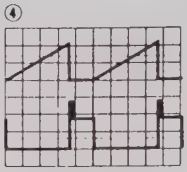
② 4.3 V, 3.3 V



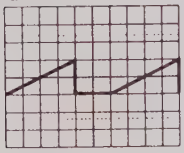
③ 4.4 V, 3.3 V



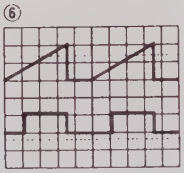
④ 2.7 V, 1.7 V, 0 V



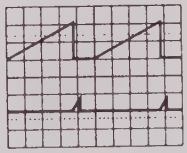
⑤ 3.7 V, 1.6 V



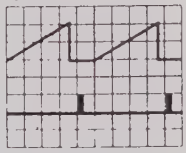
⑥



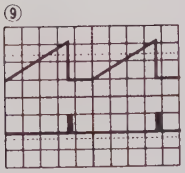
⑦ 3.8 V, 3 V



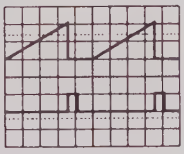
⑧ 4.4 V, 3.4 V



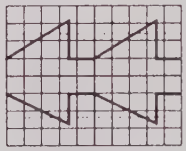
⑨ 4.4 V, 3.4 V



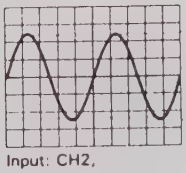
⑩ 4.4 V, 3.4 V



⑪-1 0.6 V, −1.5 V

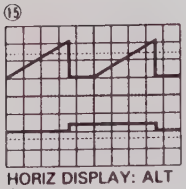


⑪-2 1 Vp-p



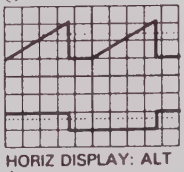
Input: CH2,
H DISPLAY: X-Y

⑮ 0.68 V, 0.64 V



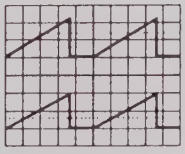
HORIZ DISPLAY: ALT
▲▼TRACE SEP: Fully CCW

⑯ 10.0 V, 9.5 V

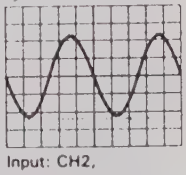


HORIZ DISPLAY: ALT
▲▼TRACE SEP: Fully CCW

⑫-1 0.5 V, −1.4 V

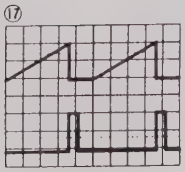


⑫-2 0.9 Vp-p

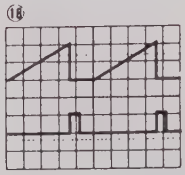


Input: CH2,
H DISPLAY: X-Y

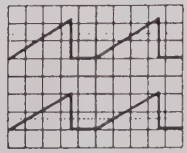
⑰ 4.8 V, 2.7 V



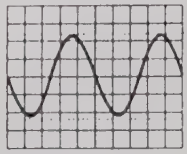
⑱ 3.2 V, 0.6 V



⑬-1 11.8 V, 9.8 V

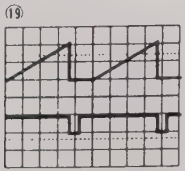


⑬-2 0.9 Vp-p

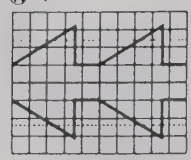


Input: CH2,
H DISPLAY: X-Y

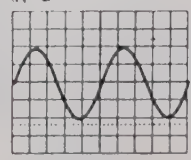
⑲ 4.2 V, 3.3 V



⑭-1 11.5 V, 9.8 V

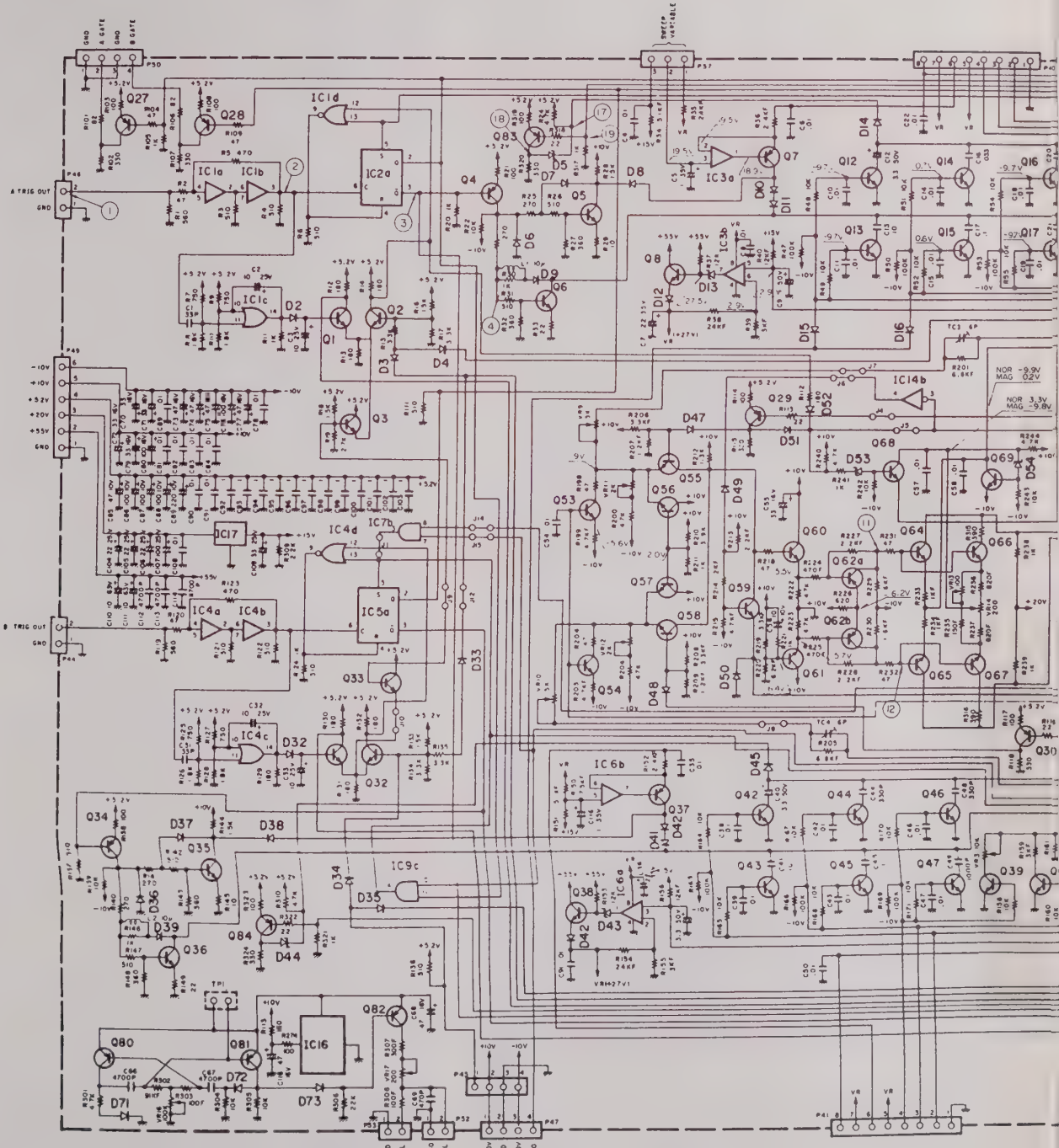


⑭-2 0.8 Vp-p



Input: CH2,
H DISPLAY: X-Y

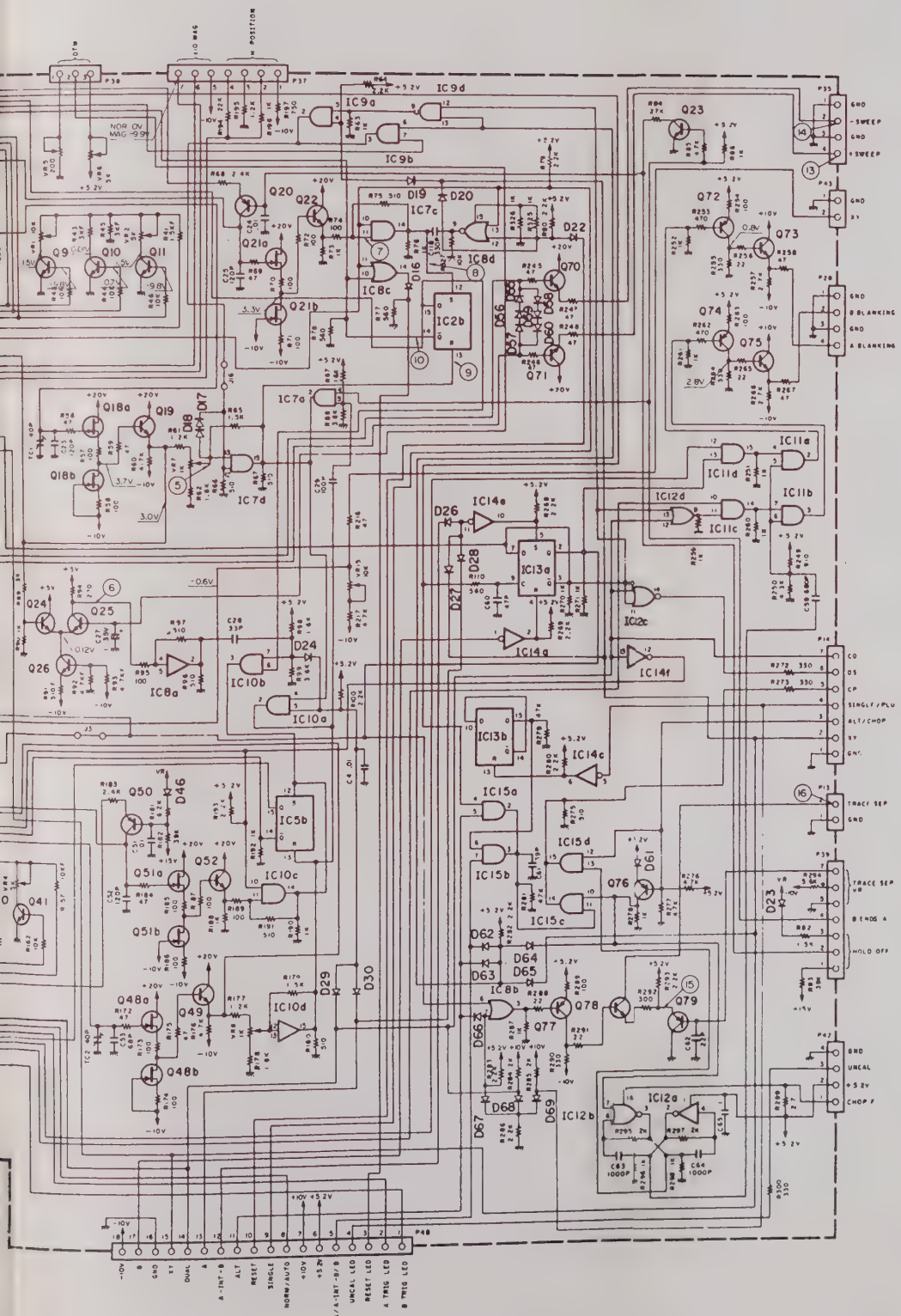
TRIG SWEEP UNIT (X74-1350-00)



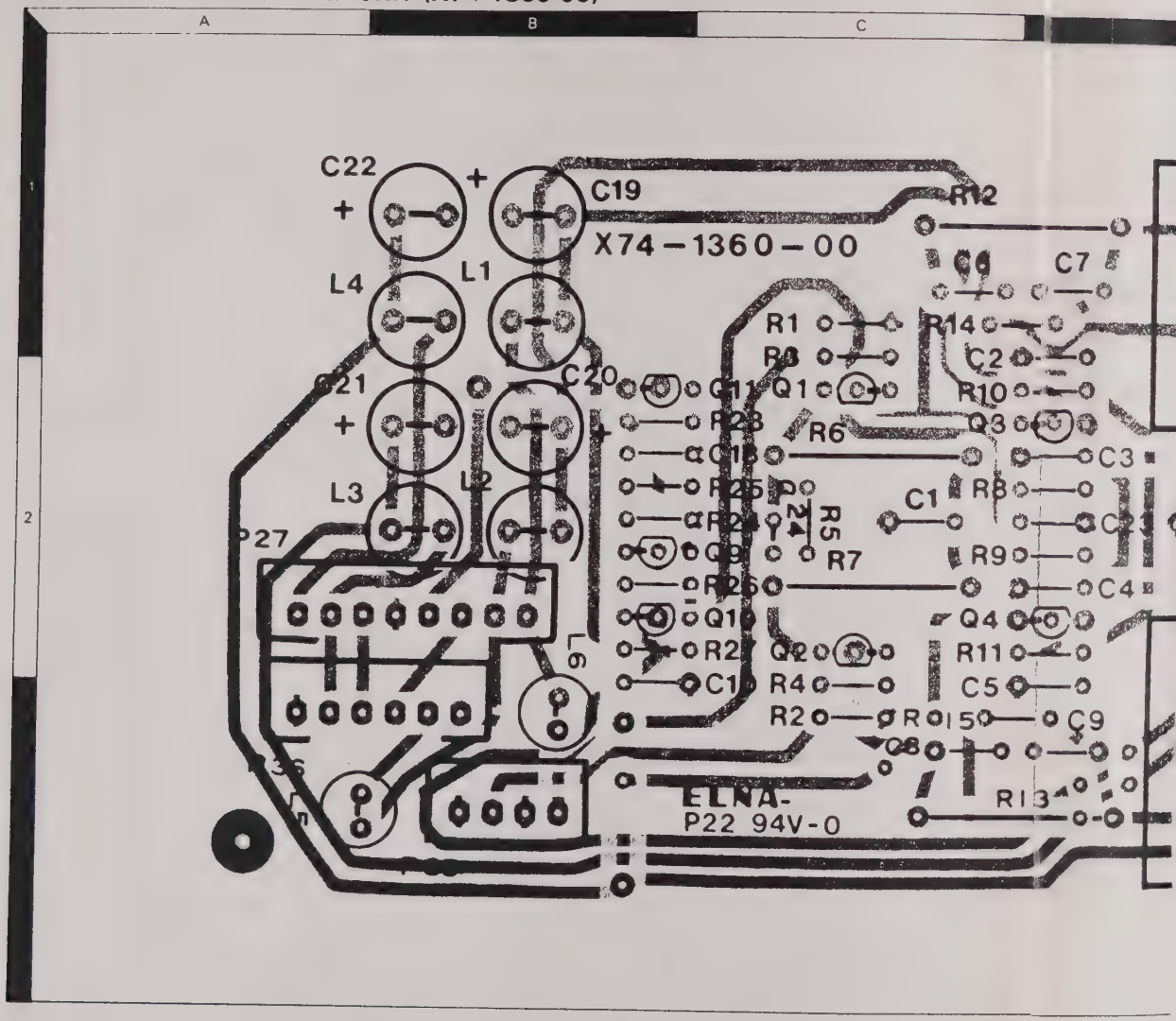
Q4,27~30,34,72,74,77,83,84 : 2SA1323(B)
Q7,20,37,50,76,79~82 : 2SA1309(Q, R)
Q6,36 : 2SC1973(T)
Q19,22,49,52,55~61,64~66,70,71 : 2SC3315(C,D)
Q5,35,73,75 : 2SC3354(T,S)
Q8,38 : 2SD438(F)
Q1~3,9~17,23~26,31~33,39~47,53,54,68,69,78 : 2SC3311(R)
Q18,21,48,51 : M47F(C)
Q62 : 2SA1239

IC16 : MC78L05CP
IC17 : MC78L15ACP
IC3,6 : LF412CN
IC12 : MC10102L
IC8 : MC10103L
IC7,9~11,15 : MC10104L
IC13 : MC10131L
IC14 : SN7406N
IC1,4 : MC10H103L
IC2,5 : MC10H131L

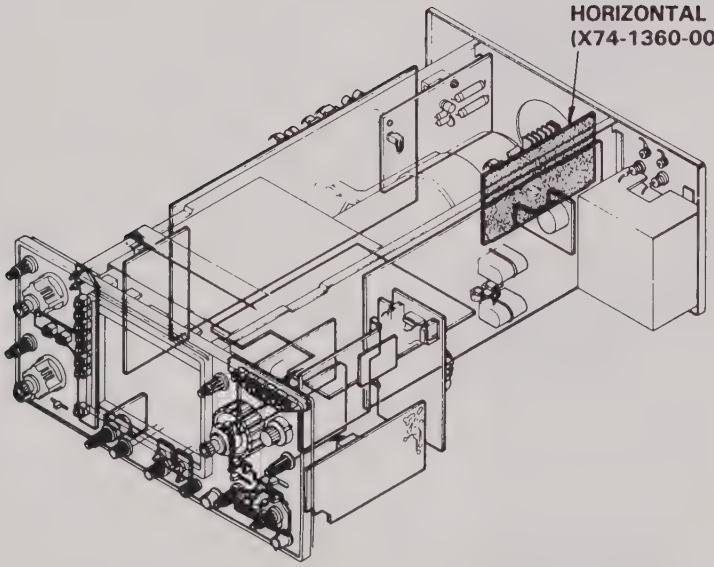
D7,9,12,37,39,42 : 1SS132
D1~4,6,8,10,11,14~22,23~36,38,40,41,45~52,56~59,61~69,71,72
D5,44 : MTZ-3.0JB
D70 : MTZ-10JC
D53,54 : MTZ-12JC
D13,43 : MTZ-15JC
D55,60 : SV06Y
D73 : 1N60



HORIZONTAL OUTPUT AMP UNIT (X74-1360-00)

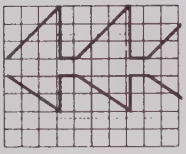


E
F
Q5
E
C C
B
Q7
B
E
B
R19
R21
+
C14
+X
1
C11
C15
C13
R16
R17
D1
D2
R18
C12
C17
R
22
C16
Q8
B
E
C C
B
R20
+
-X
2

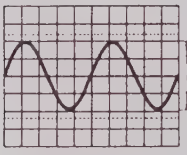

HORIZONTAL OUTPUT AMP UNIT
(X74-1360-00)

WAVEFORMS

①-1

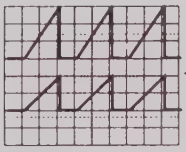


①-2

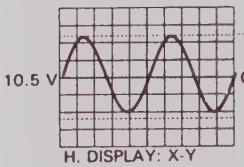


H. DISPLAY: X-Y

②-1

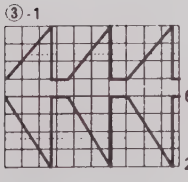


②-2

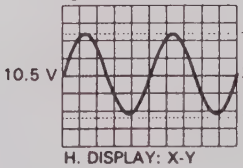


H. DISPLAY: X-Y

③-1

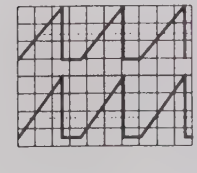


③-2

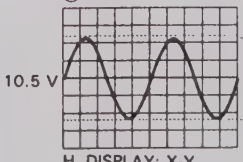


H. DISPLAY: X-Y

④-1

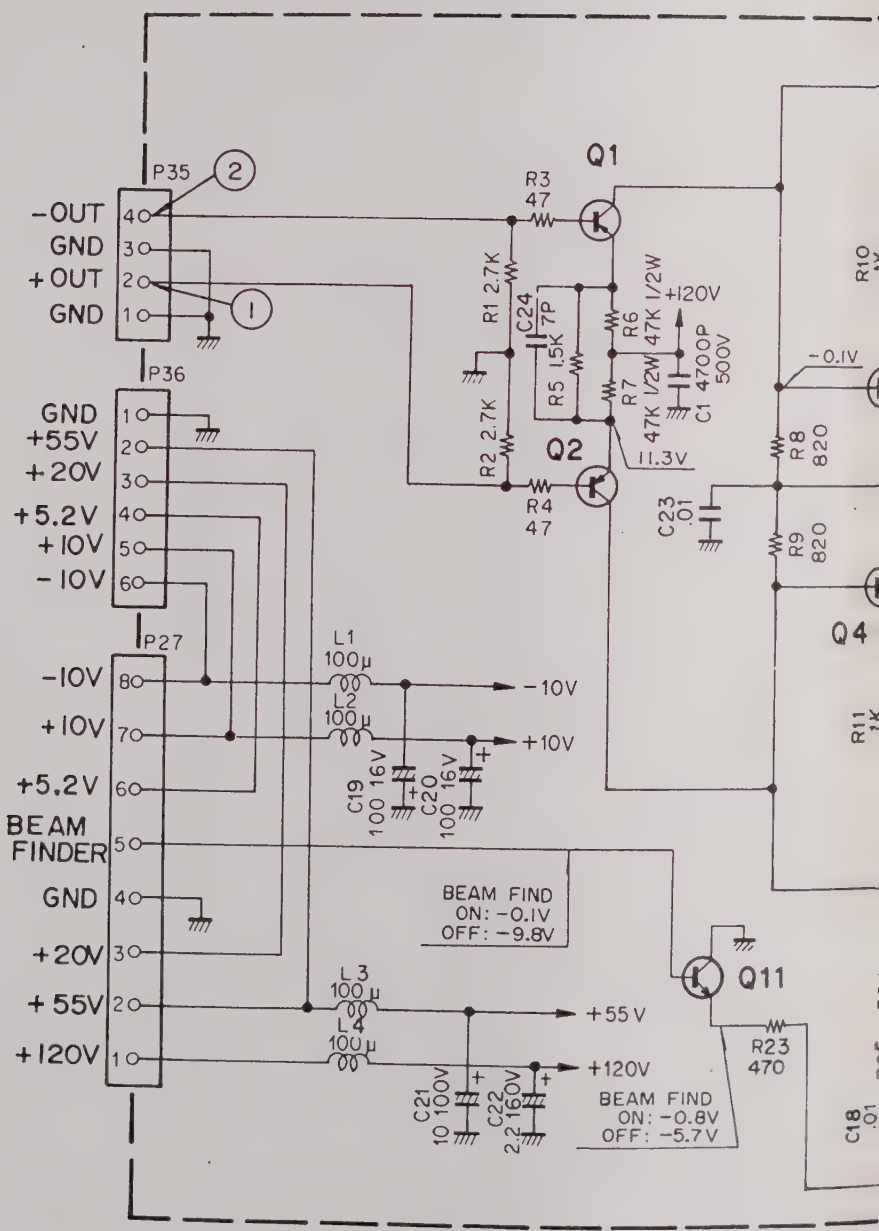


④-2

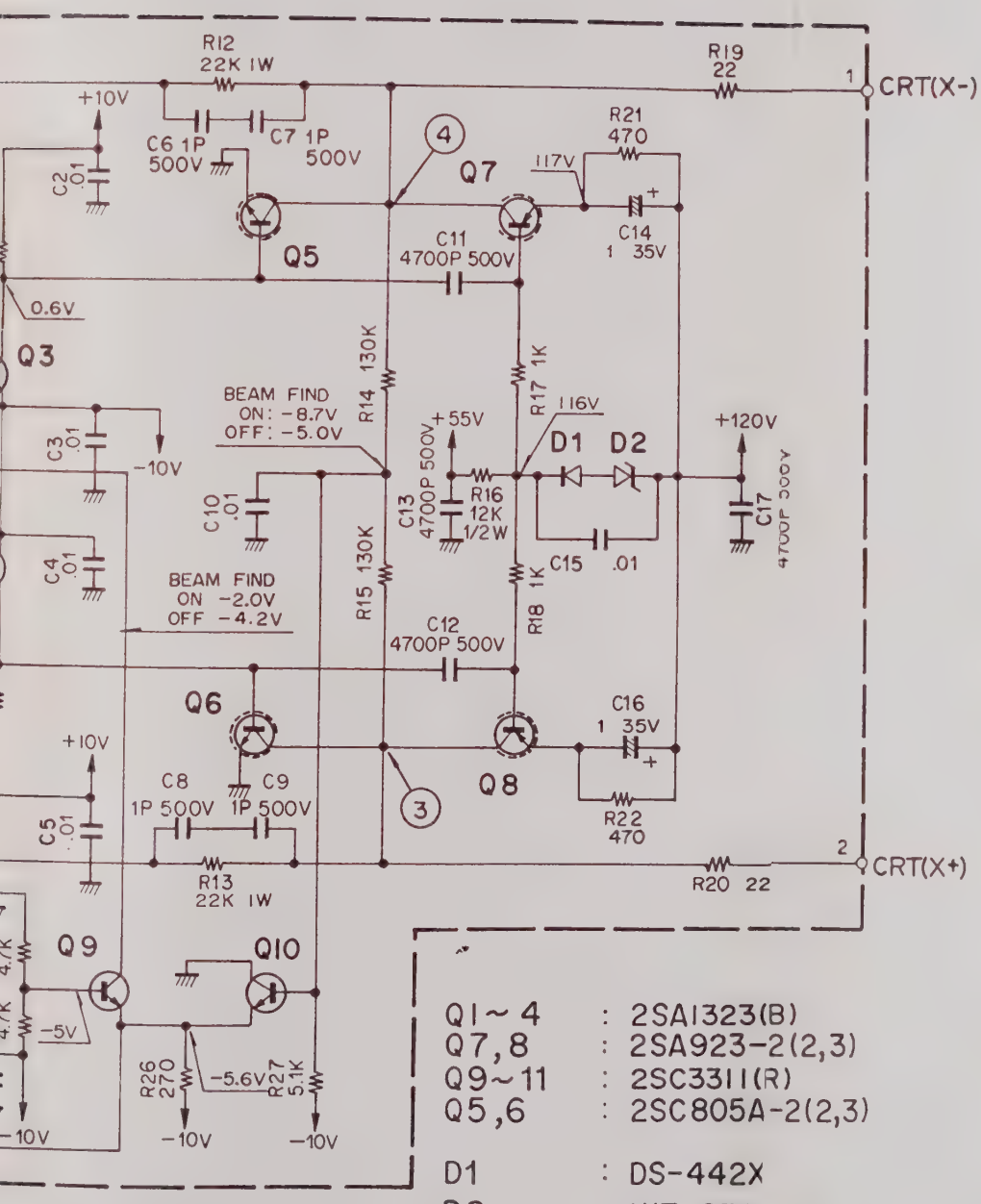


H. DISPLAY: X-Y

HORIZONTAL OUTPUT AMP UNIT (X74-1360-00)

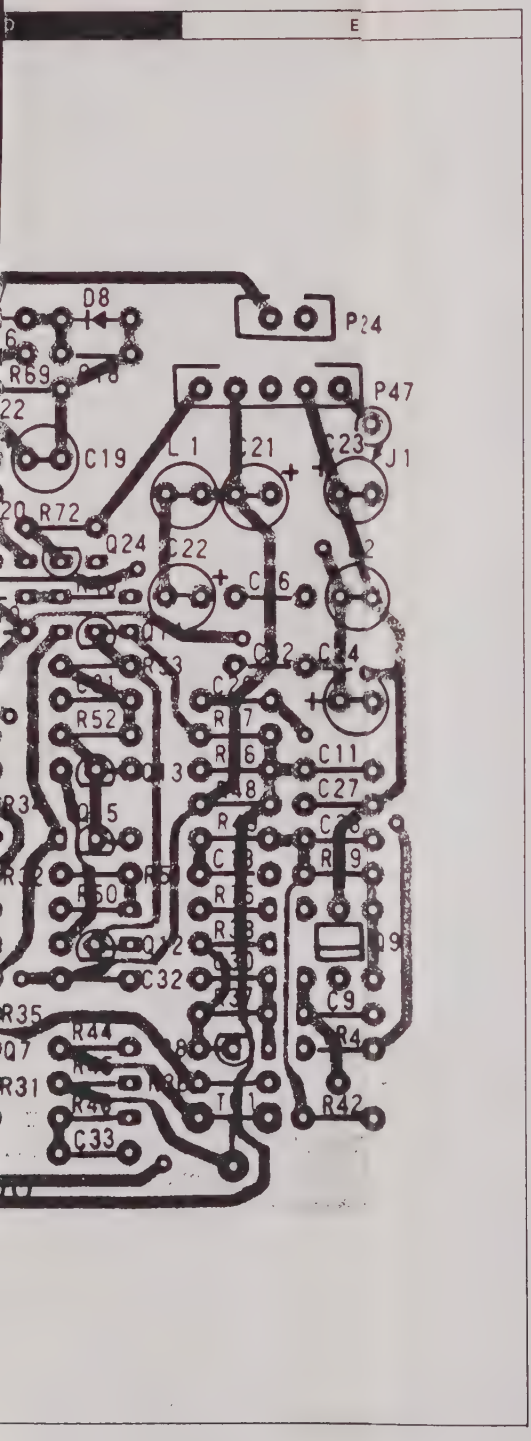


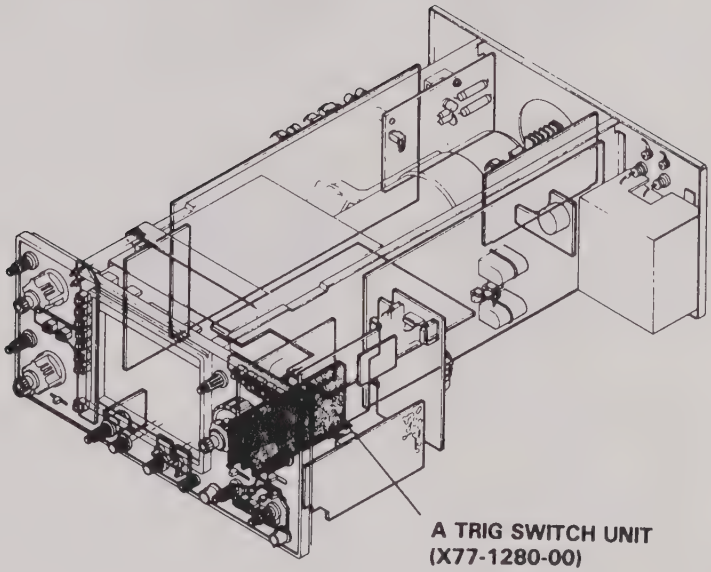
DIAGRAM



Q1~4 : 2SA1323(B)
Q7,8 : 2SA923-2(2,3)
Q9~11 : 2SC3311(R)
Q5,6 : 2SC805A-2(2,3)

D1 : DS-442X
D2 : WZ-050

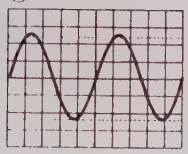

D
E
D8
P24
R69
P47
C19
L1
C21
C23
J1
R72
Q24
C22
C16
C12
C14
R52
R7
R6
C11
C27
R9
R50
C32
C9
R4
R35
R44
R31
R42
C33



A TRIG SWITCH UNIT
(X77-1280-00)

WAVEFORMS

①



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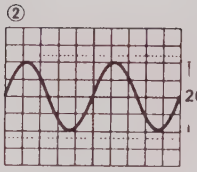

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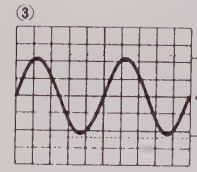

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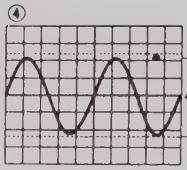

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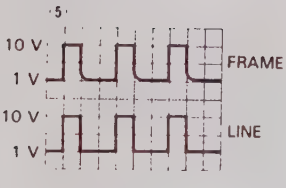

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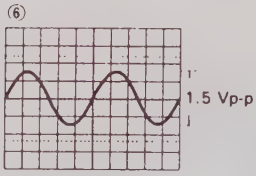
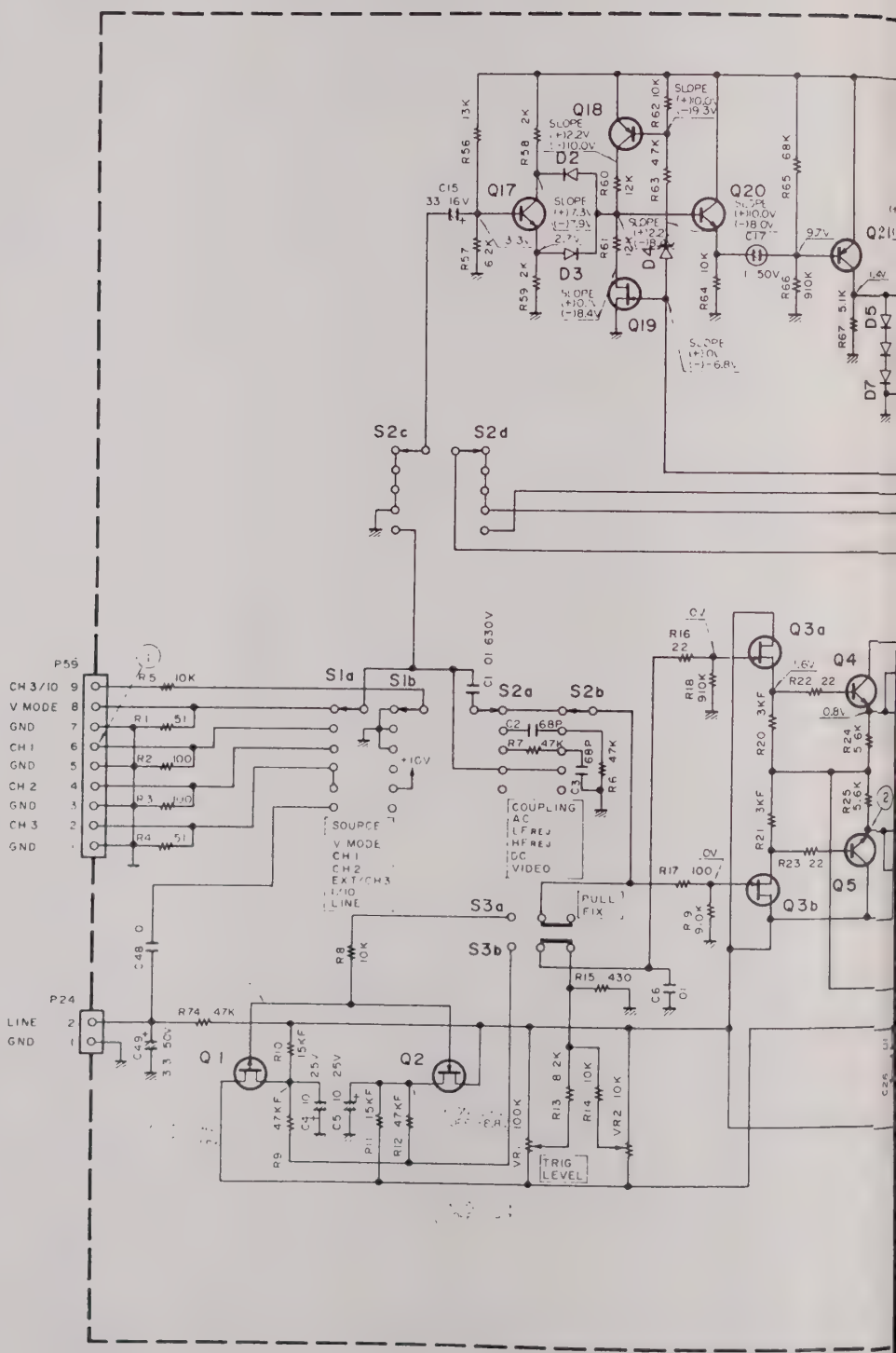
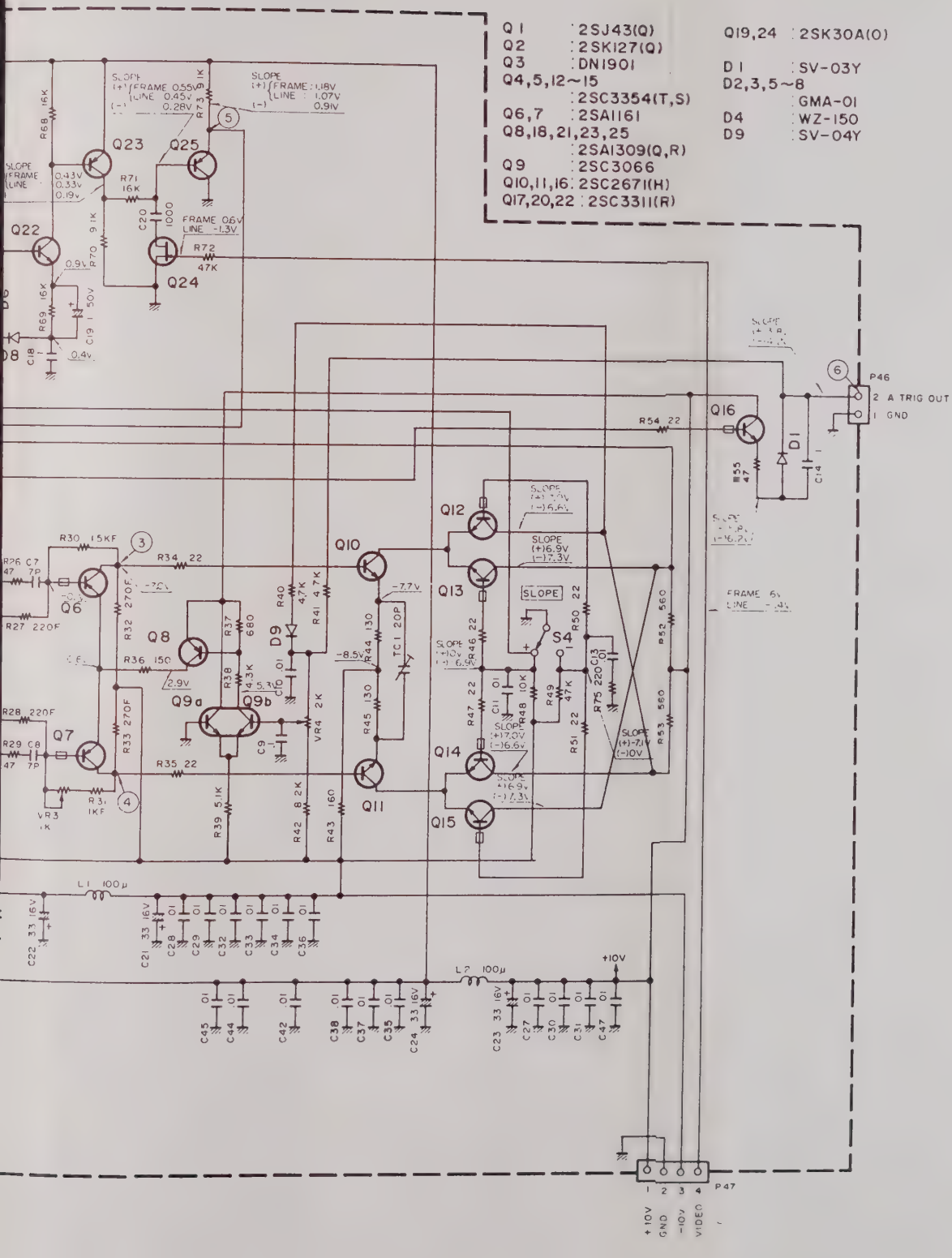


A TRIG SWITCH UNIT (X77-1280-00)

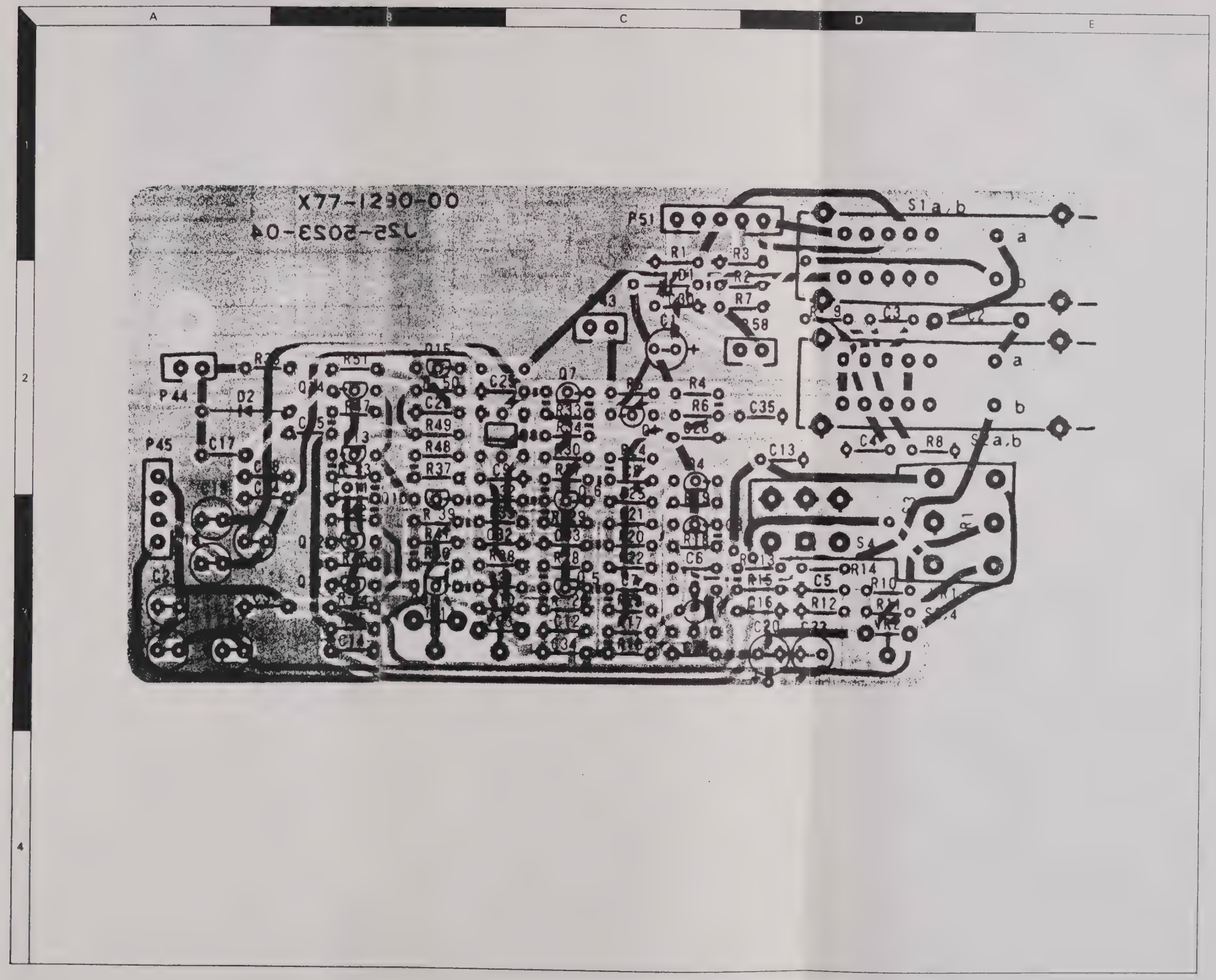


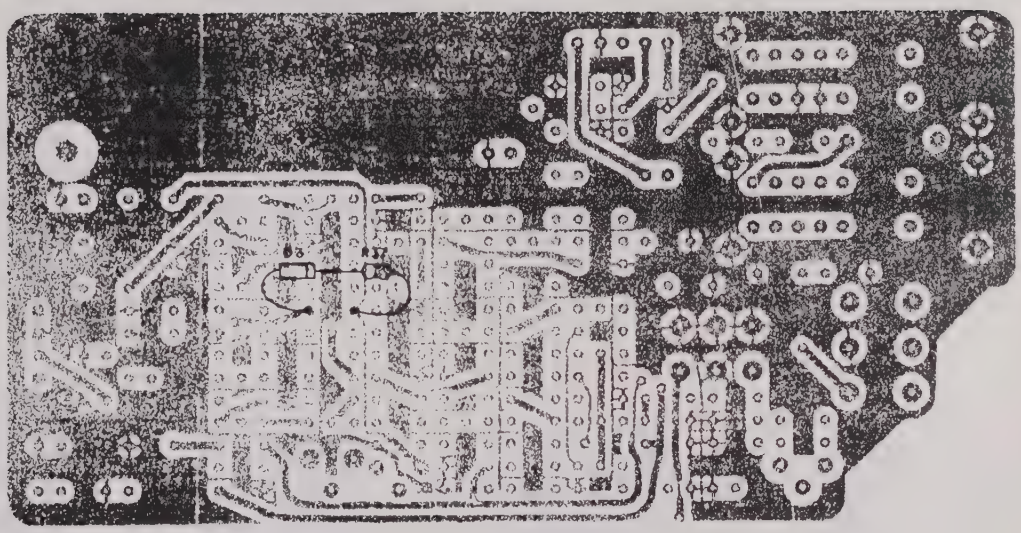
TIC DIAGRAM


Q1 : 2SJ43(Q)
Q2 : 2SK127(Q)
Q3 : DN1901
Q4,5,12~15 : 2SC3354(T,S)
Q6,7 : 2SA1161
Q8,18,21,23,25 : 2SA1309(Q,R)
Q9 : 2SC3066
Q10,11,16 : 2SC2671(H)
Q17,20,22 : 2SC3311(R)
Q19,24 : 2SK30A(O)
D1 : SV-03Y
D2,3,5~8 : GMA-01
D4 : WZ-150
D9 : SV-04Y
P46
2 A TRIG OUT
1 GND
P47
+10V
GND
-10V
VIDEO
SLOPE
FRAME 6V
LINE -4V

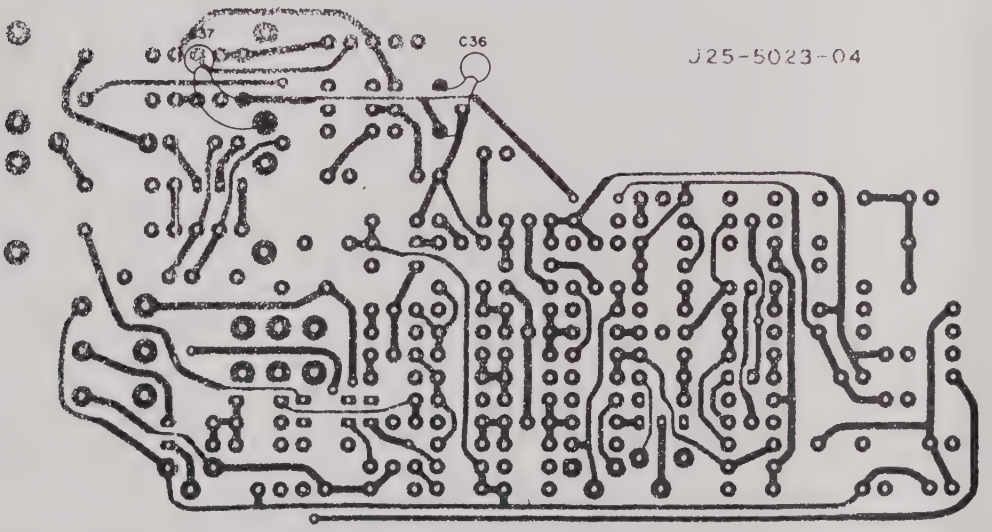
PC BOARD

B TRIG SWITCH UNIT (X77-1290-00)

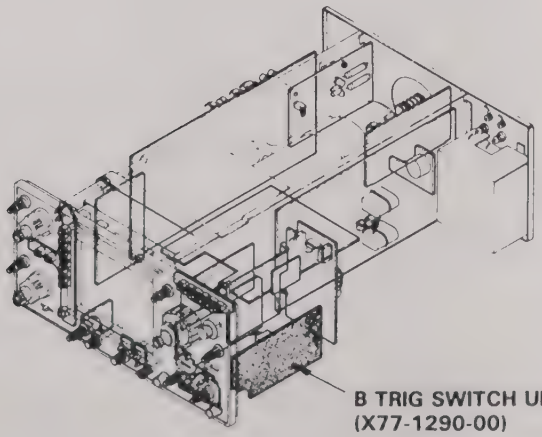




(COMPONENT SIDE VIEW)

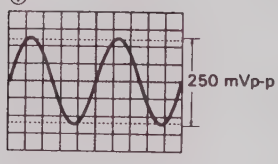


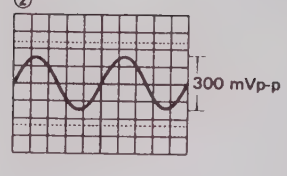
(FOIL SIDE VIEW)

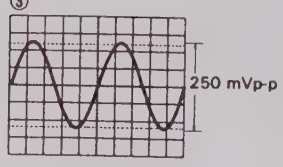


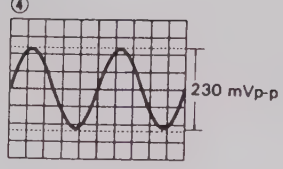
B TRIG SWITCH UNIT
(X77-1290-00)

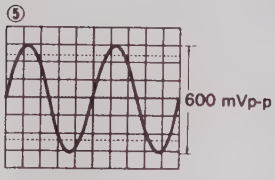
WAVEFORMS

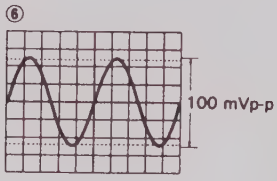
① 

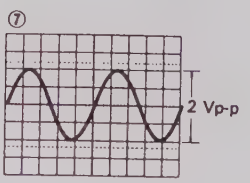
② 

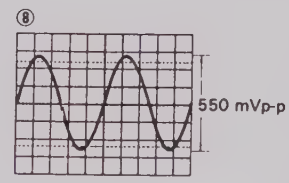
③ 

④ 

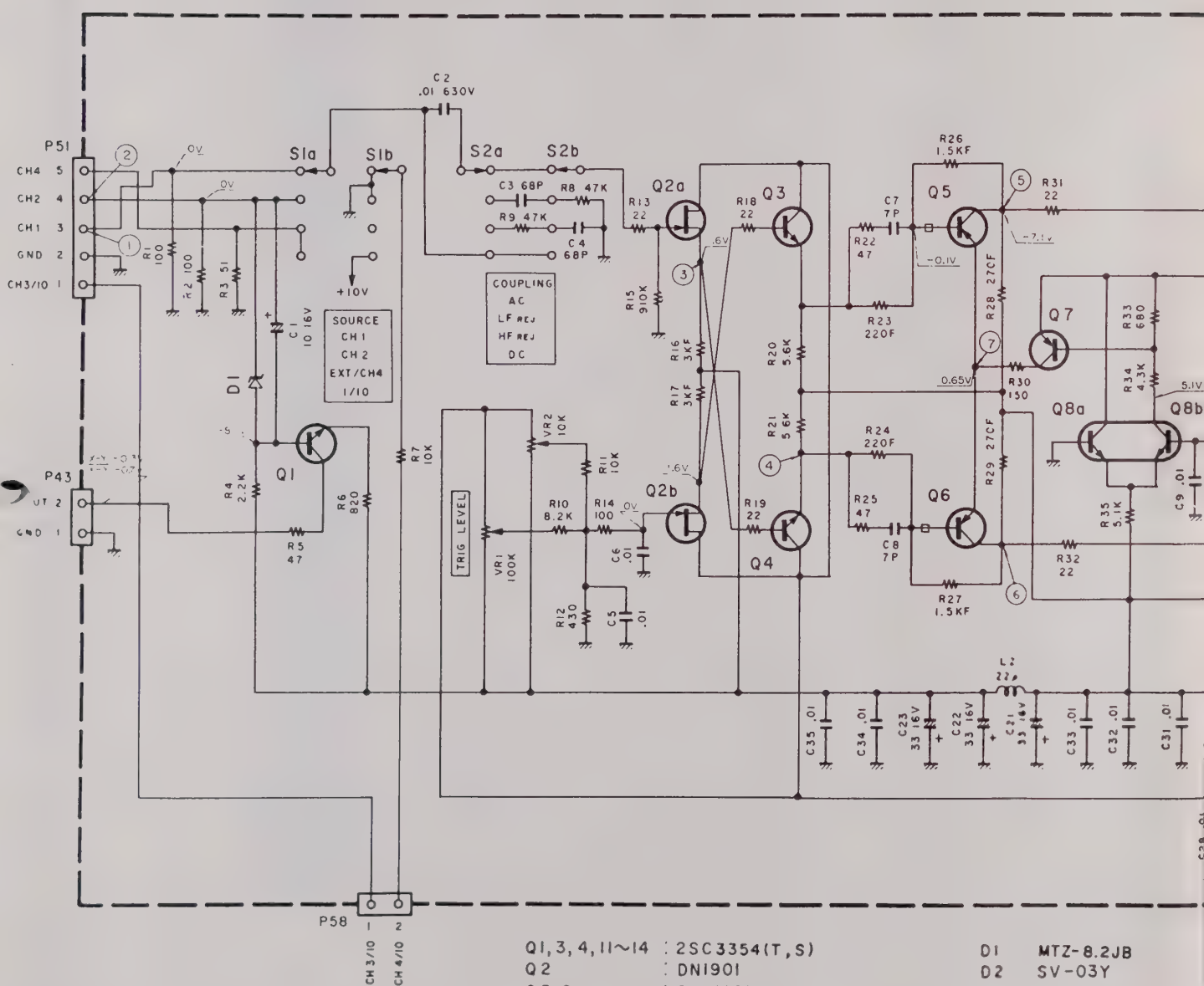
⑤ 

⑥ 

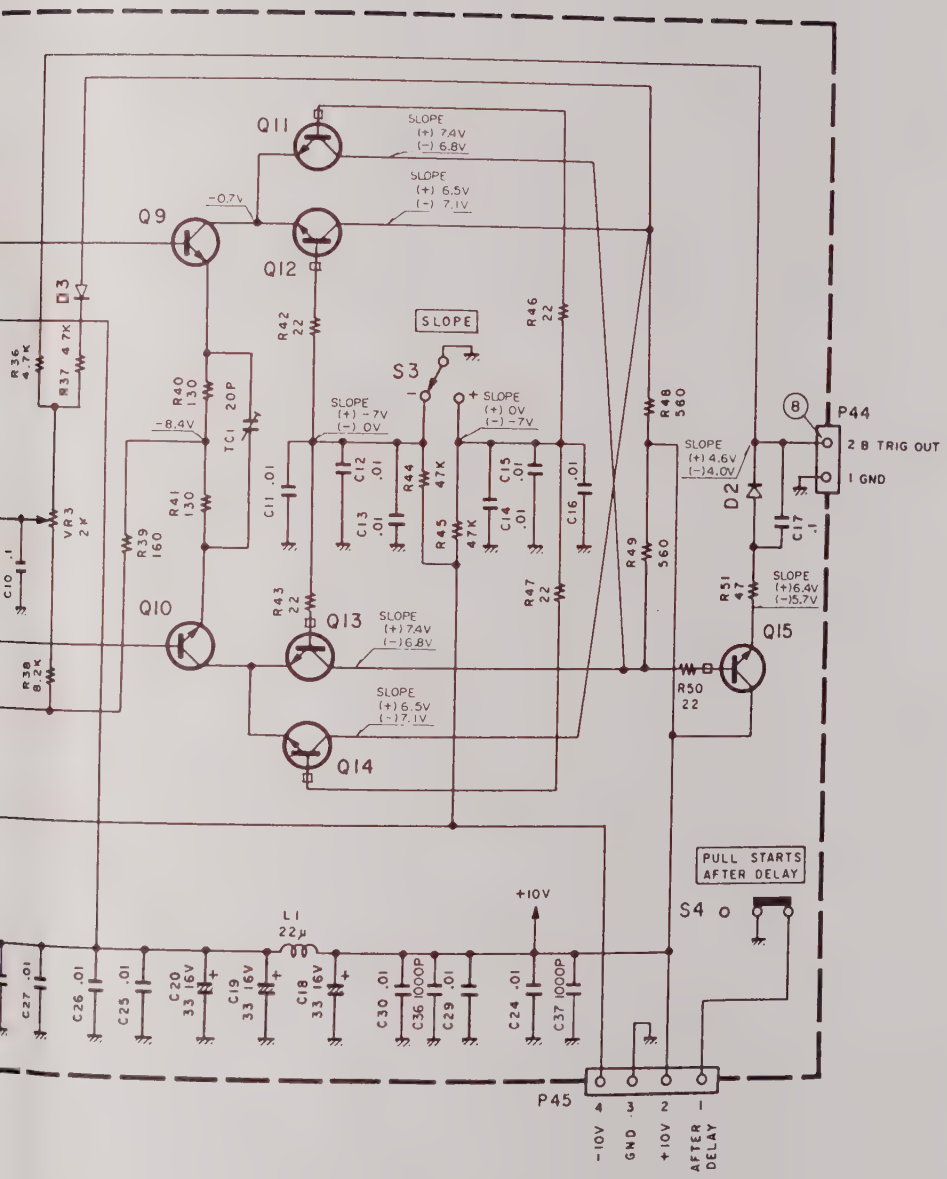
⑦ 

⑧ 

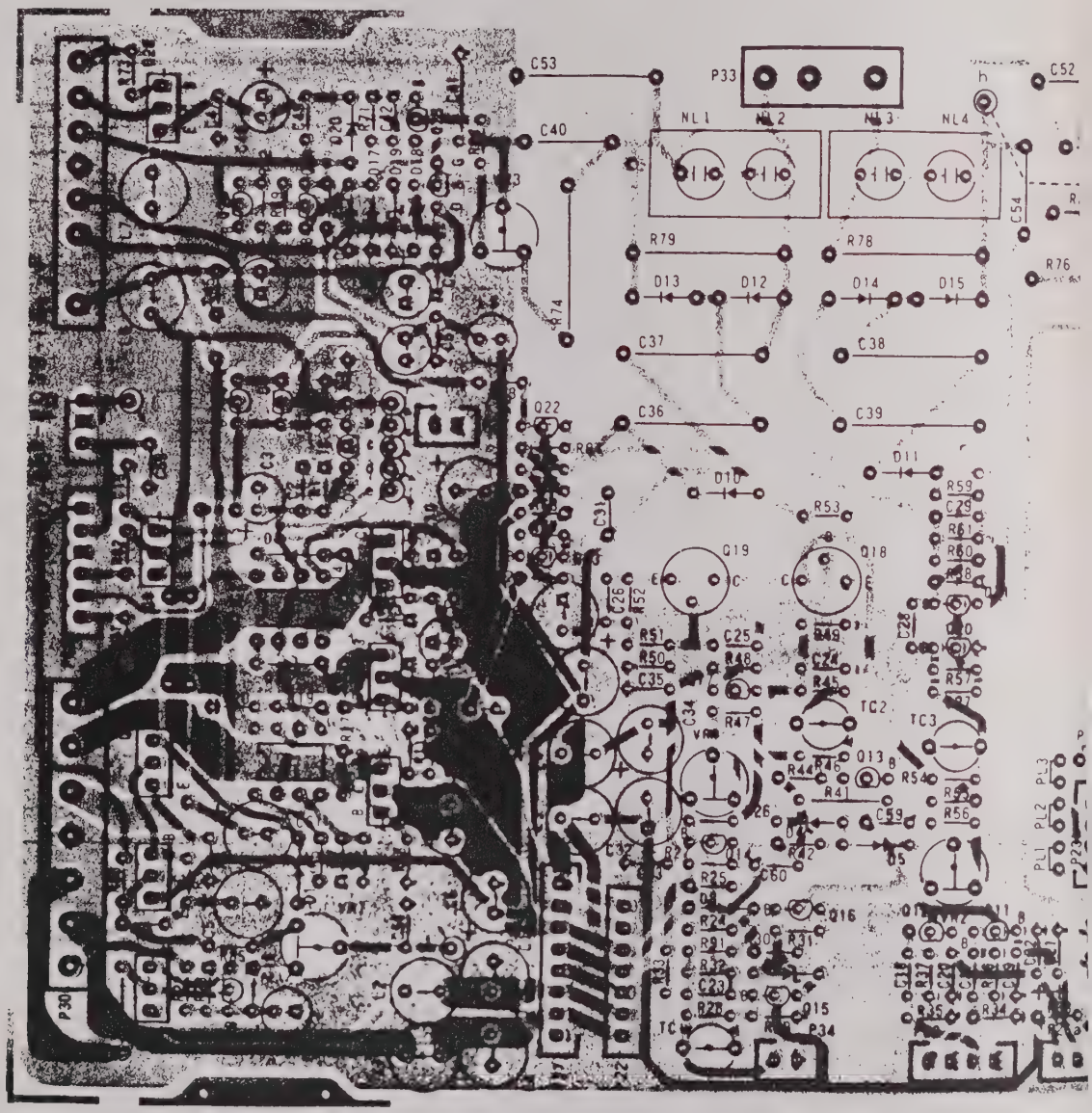
G SWITCH UNIT (X77-1290-00)

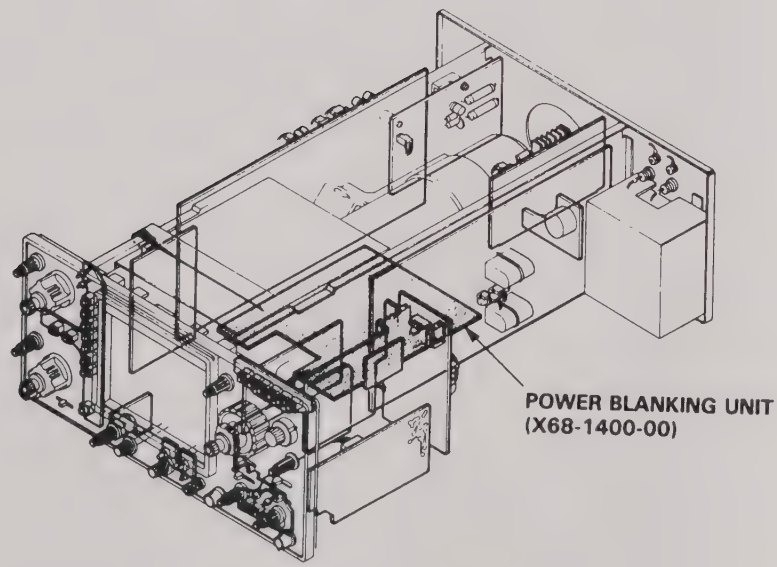


Q1,3,4,11~14	: 2SC3354(T,S)	D1	MTZ-8.2JB
Q2	: DN1901	D2	SV-03Y
Q5,6	: 2SA1161	D3	SV-04Y
Q7	: 2SA1309(Q,R)		
Q8	: 2SC3066		
Q9,10,15	: 2SC2671(H)		


Q11
SLOPE
(+) 7.4V
(-) 6.8V
SLOPE
(+) 6.5V
(-) 7.1V
Q9
-0.7v
Q12
D3
R36 4.7K
R37 4.7K
SLOPE
S3
R42 22
R46 22
R40 130
TC1 20P
SLOPE
(+) -7V
(-) 0V
+ SLOPE
(+) 0V
(-) -7V
R48 560
8
P44
2 B TRIG OUT
1 GND
-8.4V
C11 .01
C12 .01
C13 .01
R44 47K
R45 47K
C14 .01
C15 .01
C16 .01
SLOPE
(+) 4.6V
(-) 4.0V
D2
C17 .1
R41 130
R39 160
VR3 2K
C10 .1
R49 560
R47 22
R51 47
SLOPE
(+) 6.4V
(-) 5.7V
Q10
R43 22
Q13
SLOPE
(+) 7.4V
(-) 6.8V
Q15
R38 8.2K
R50 22
SLOPE
(+) 6.5V
(-) 7.1V
Q14
PULL STARTS
AFTER DELAY
S4
+10V
L1
22μ
C27 .01
C26 .01
C25 .01
C20 33 16V
C19 33 16V
C18 33 16V
C30 .01
C36 1000P
C29 .01
C24 .01
C37 1000P
P45
4
3
2
1
-10V
GND
+10V
AFTER DELAY

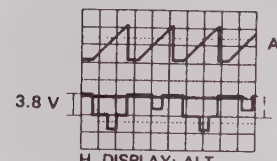
POWER BLANKING UNIT (X68-1400-00)




POWER BLANKING UNIT
(X68-1400-00)

WAVEFORMS

①



H. DISPLAY: ALT

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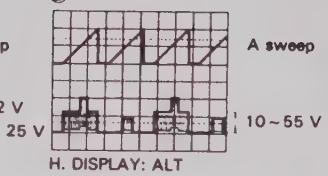
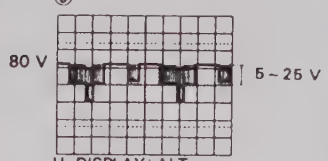


H. DISPLAY: ALT

③

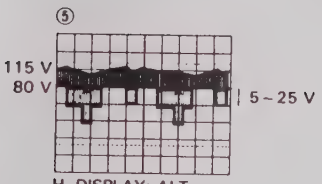


H. DISPLAY: ALT

④

H. DISPLAY: ALT

⑤



H. DISPLAY: ALT

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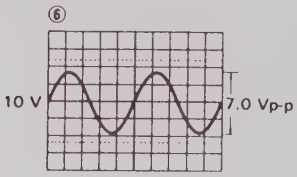

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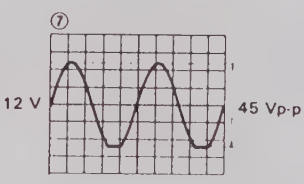
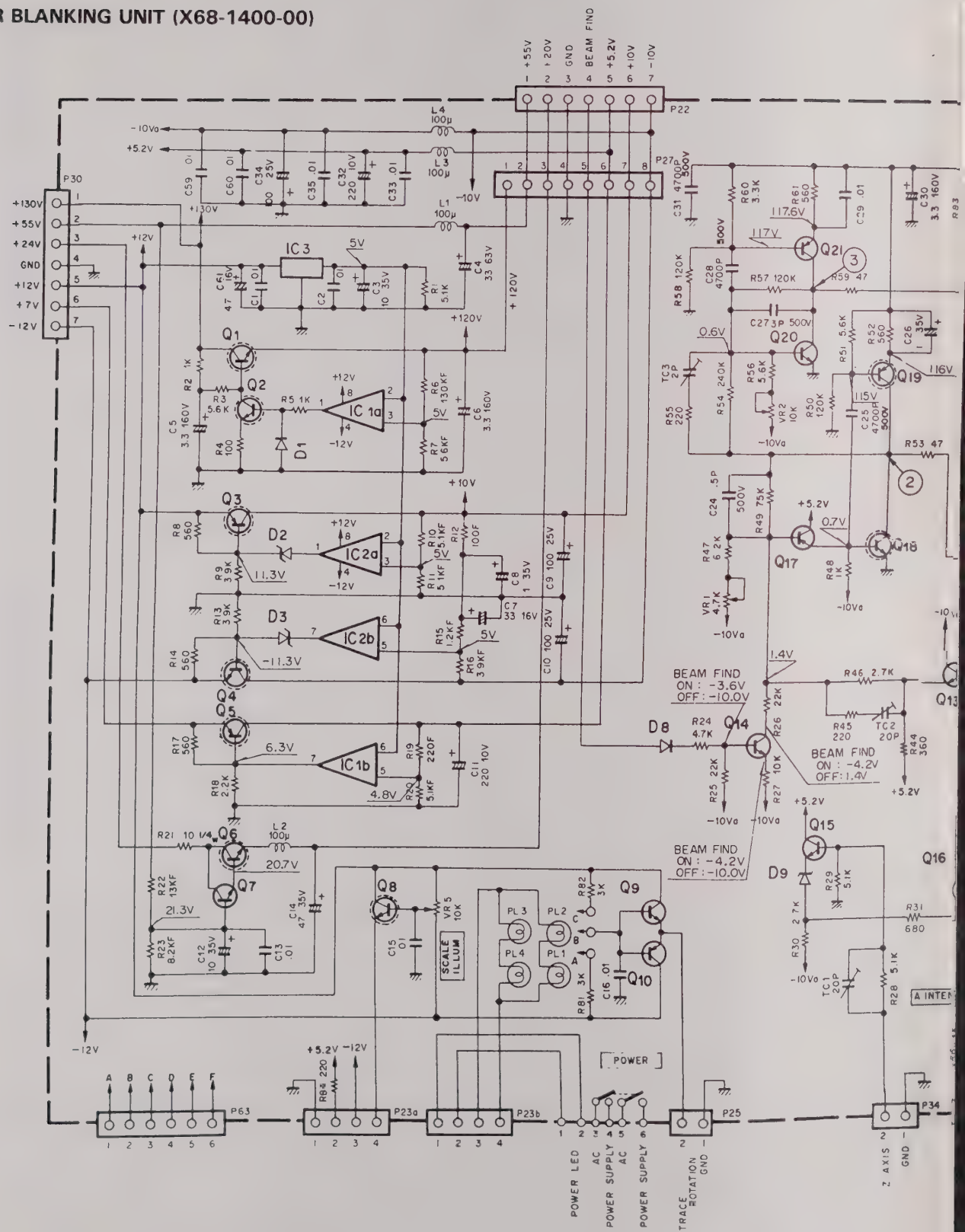
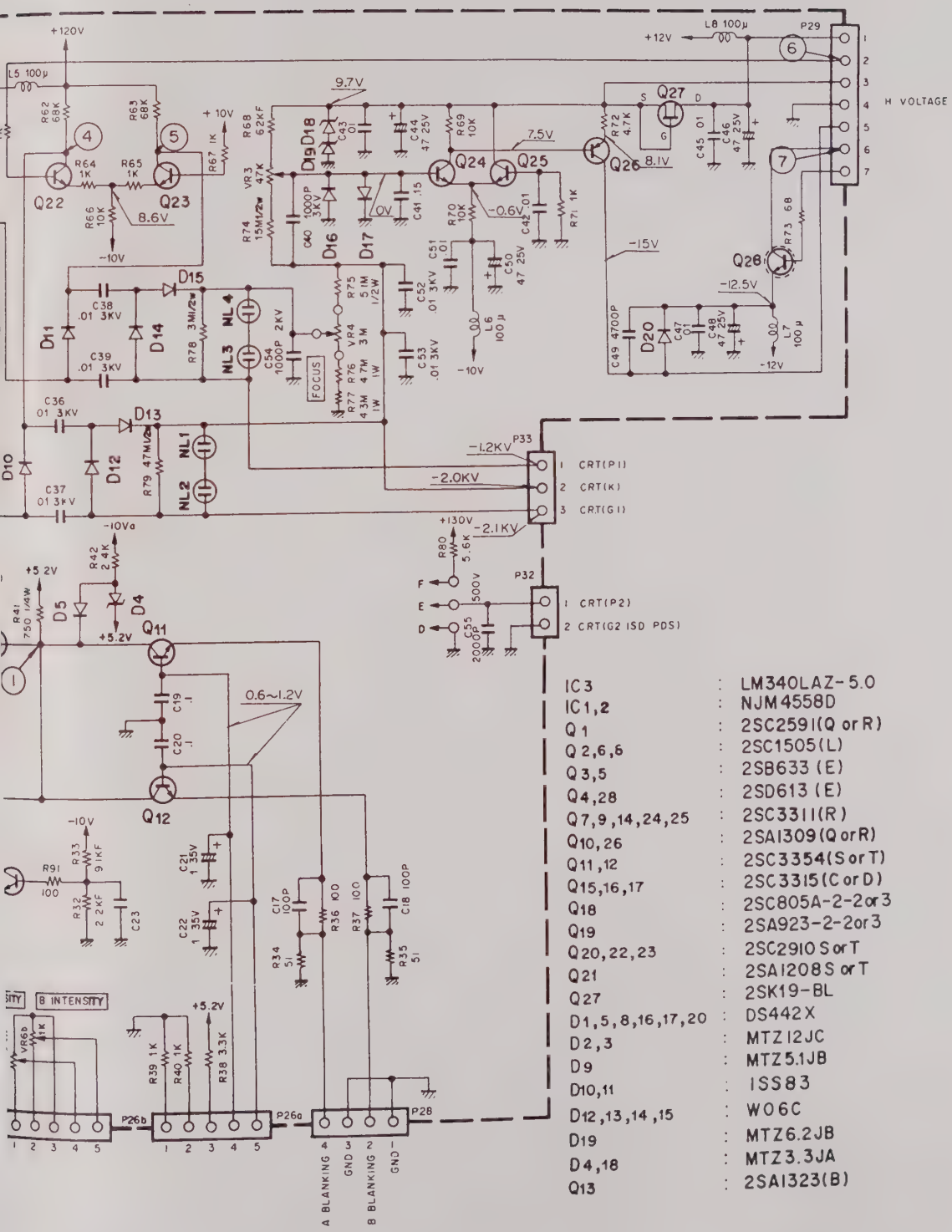


Note : IIII : CHOP Operation

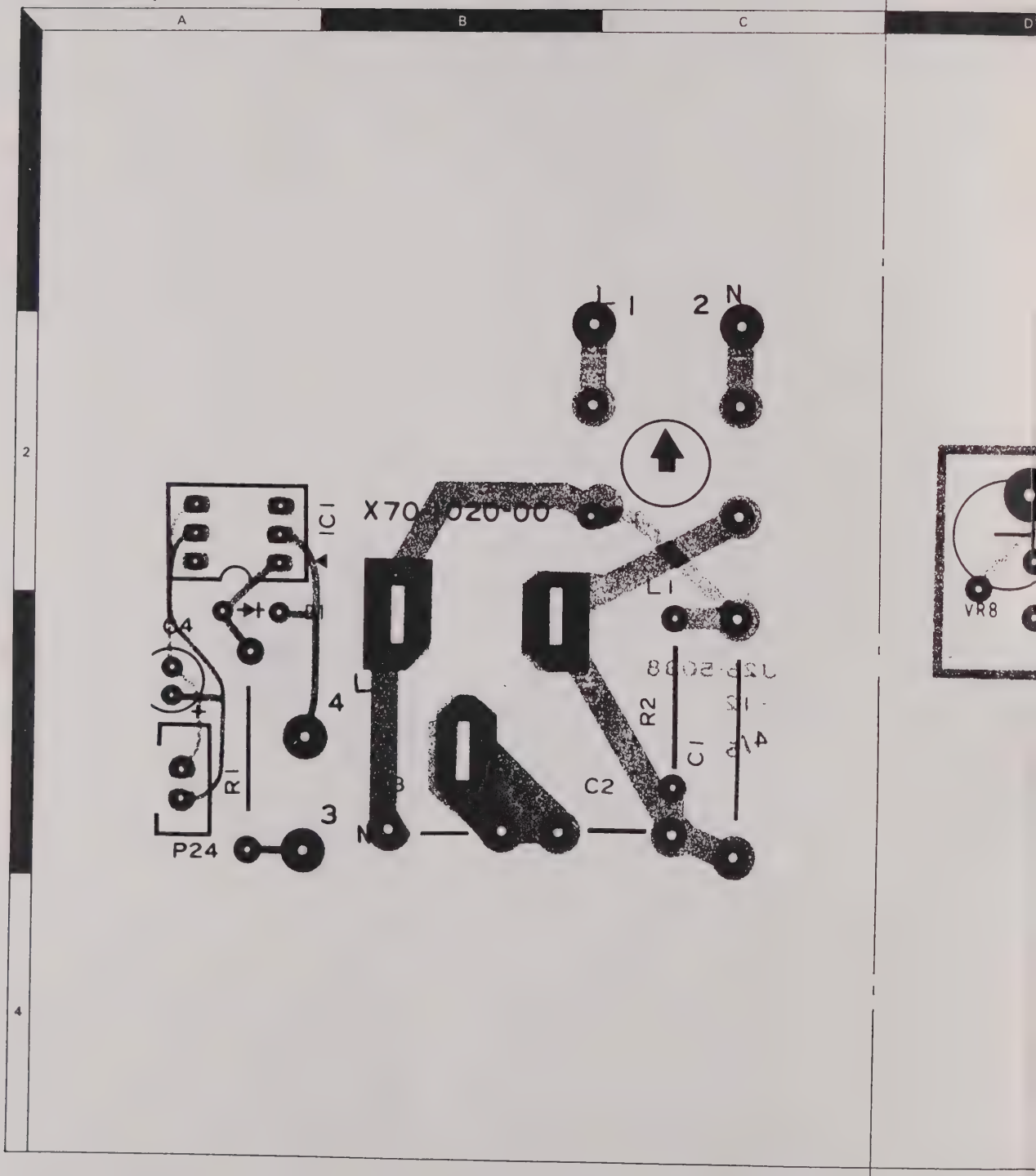
POWER BLANKING UNIT (X68-1400-00)

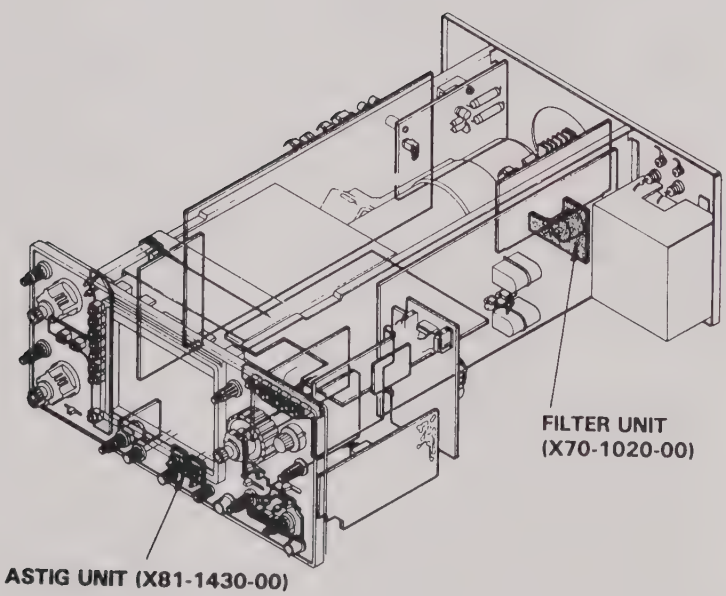




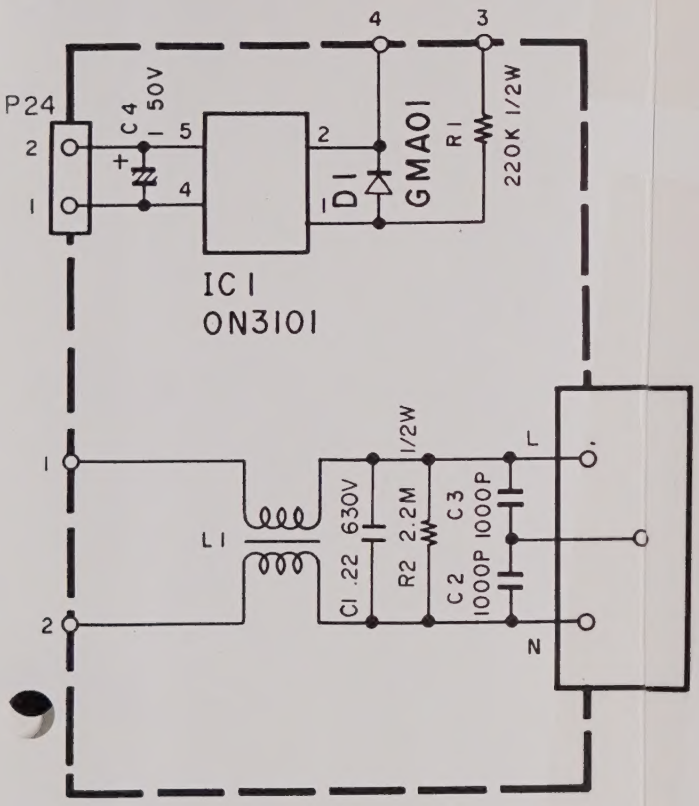
IC3	:	LM340LAZ-5.0
IC1,2	:	NJM4558D
Q1	:	2SC2911(Q or R)
Q2,6,6	:	2SC1505(L)
Q3,5	:	2SB633 (E)
Q4,28	:	2SD613 (E)
Q7,9,14,24,25	:	2SC3311(R)
Q10,26	:	2SA1309(Q or R)
Q11,12	:	2SC3354(S or T)
Q15,16,17	:	2SC3315(C or D)
Q18	:	2SC805A-2-2or3
Q19	:	2SA923-2-2or3
Q20,22,23	:	2SC2910 S or T
Q21	:	2SA1208 S or T
Q27	:	2SK19-BL
D1,5,8,16,17,20	:	DS442X
D2,3	:	MTZ12JC
D9	:	MTZ5.1JB
D10,11	:	1SS83
D12,13,14,15	:	W06C
D19	:	MTZ6.2JB
D18	:	MTZ3.3JA
D4,18	:	2SA1323(B)
Q13	:	

FILTER UNIT (X70-1020-00)

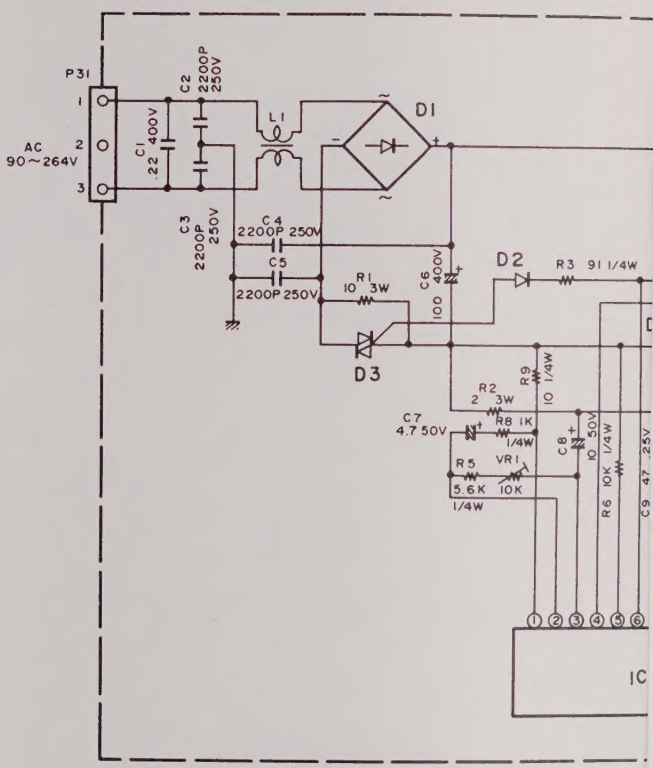



FILTER UNIT
(X70-1020-00)
ASTIG UNIT (X81-1430-00)

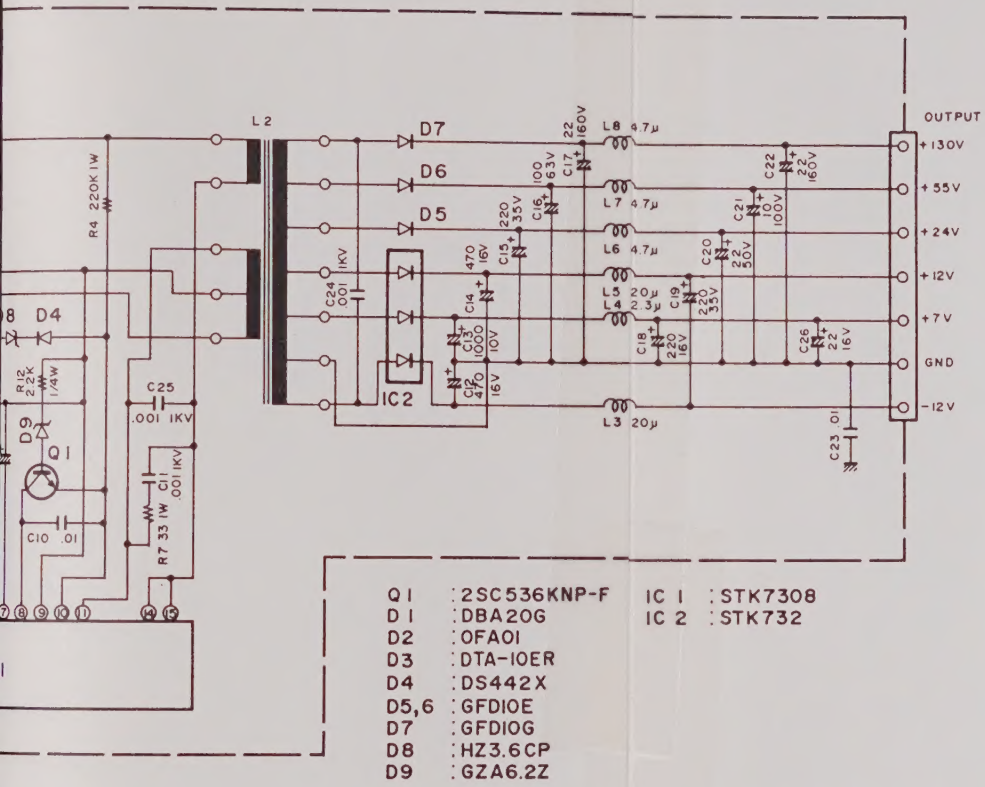
FILTER UNIT (X70-1020-00)



SWITCHING POWER SUPPLY UNIT (W02-041

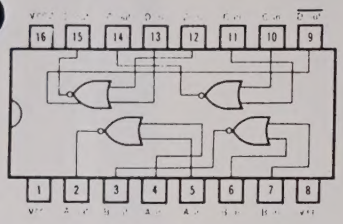


3-05)

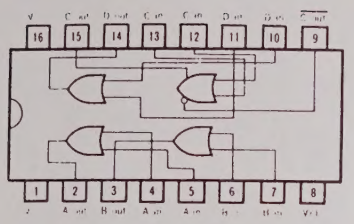


Q1	: 2SC536KNP-F	IC 1	: STK7308
D1	: DBA20G	IC 2	: STK732
D2	: OFA01		
D3	: DTA-10ER		
D4	: DS442X		
D5,6	: GFD10E		
D7	: GFD10G		
D8	: HZ3.6CP		
D9	: GZA6.2Z		

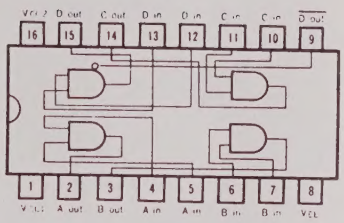
C-MOS IC



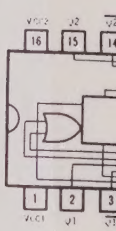
MC10102L



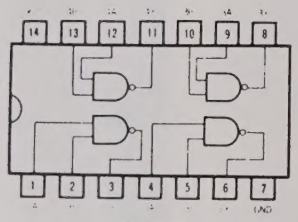
MC10103L
MC10H103L



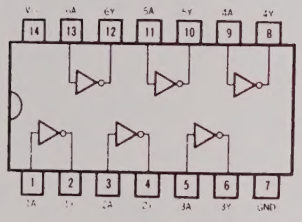
MC10104L



TTL IC

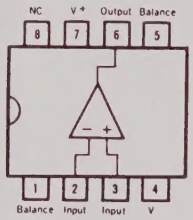


SN7400N

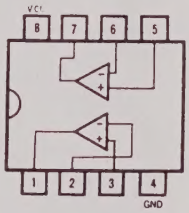


SN7406N

OTHER



LF441ACN



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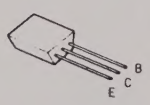
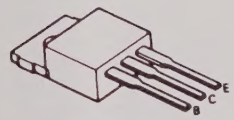
ON3101

TRANSISTOR

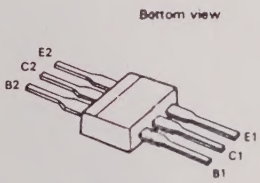
2SC1973(T)
2SC2910(S or T)
2SA1208(S or T)
2SD438(F)



2SC3354(T, S)
2SC3315(C, D)
2SC3311(Q, R)
2SA1309(Q, R)
2SA1323(B)



2SC2591(Q, R)
2SB633(E)
2SD613(E)
2SC1505(L)



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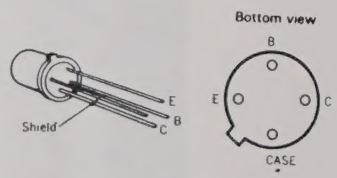

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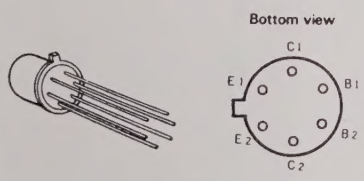
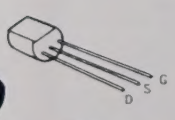
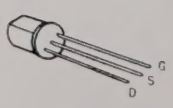


2SC1733

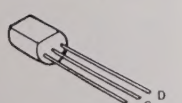
FET



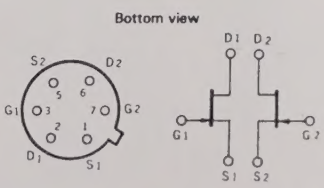
J304



2SK19(BL)

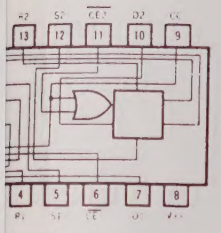


2SK30A(O)
2SK127(Q)
2SJ43(Q)

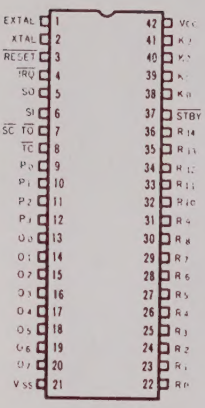


DN1901

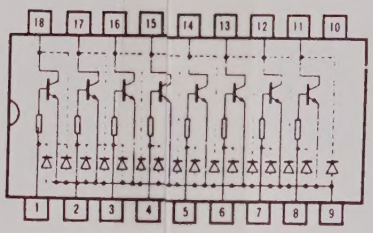
CPU



MC10131L
MC10H131L



MTM-5010



AN90B20

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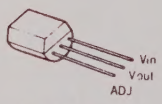

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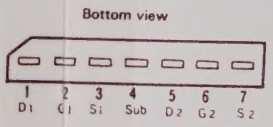
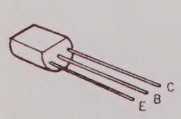
LM317LZ

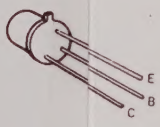


M47F(C)

2SC2671(H)
2SA1161
2SC2644



2SA1206



2SA923-2-2 or 3
2SC805A2-2 or 3